MEDICAL WAR MANUAL No. 2

NOTES FOR ARMY MEDICAL OFFICERS

GOODWIN

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MEDICAL WAR MANUAL No. 2

Authorized by the Secretary of War
and under the Supervision of the Surgeon-General
and the Council of National Defense

Notes for Army Medical Officers

BY

LT.-COL. T. H. GOODWIN, R.A.M.C.
AUTHOR OF NOTES FOR MEDICAL OFFICERS ON FIELD SERVICE IN INDIA
AND FIELD SERVICE NOTES FOR R.A.M.C.

WITH AN INTRODUCTORY NOTE BY
SURGEON-GENERAL WILLIAM C. GORGAS, U.S.A.

Illustrated

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PREFACE.

THIS small book, the outcome of a series of lectures delivered at the Army Medical School in Washington, is published by kind permission of the Surgeon-General, United States Army.

The author can lay claim to but little that is original as regards the contents, these having been largely obtained from various official books and publications, while, as regards the chapter on Sanitation, the writer's indebtedness is due to Major Lelean, the substance matter contained in the chapter having been, in the main, obtained from that officer's book, *Sanitation in War*.

The author owes a lasting debt of gratitude to the United States Army Medical Officers for the kind reception which they accorded to his lectures.

It is entirely in response to their appeals that he ventures to publish these notes, and he does so in the sincere hope that they may possibly be found useful to the many young medical officers who will shortly find themselves on active service.

T. H. GOODWIN,
Acting Colonel, Army Medical Service.

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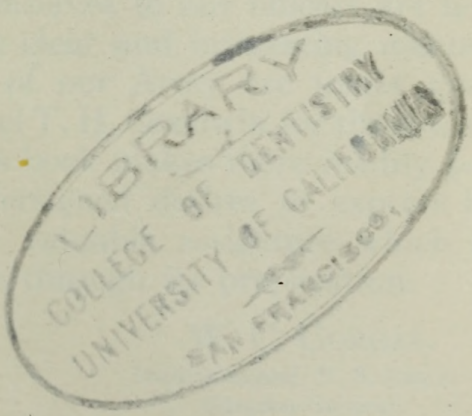

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FOREWORD.

THESE "Notes for Army Medical Officers" are elaborated from a series of lectures given by Colonel T. H. Goodwin, C.M.G., D.S.O., before the classes at the Army Medical School, Washington, D. C.

They are based upon the long practical experience of the distinguished author at the front, and include much information which will be of the greatest value for members of our Medical Service as they go abroad on active duty with troops in France. Many of the perplexing questions which have presented themselves to our officers are here answered in a most clear and interesting manner.

Medical Officers of our Army are under great obligations to Colonel T. H. Goodwin for the greater efficiency which this book makes more readily possible, and the undersigned desires to express his appreciation of the valuable assistance which he has given this office through its preparation.

W. C. GORGAS,
Major-General, U. S. Army,
Surgeon-General.

SURGEON-GENERAL'S OFFICE,
War Department, Washington,
September 12, 1917.

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NOTES FOR ARMY MEDICAL OFFICERS.

ORGANIZATION AND ADMINISTRATION.

THE fundamental object of the Army Medical Service in war is to provide healthy men for the fighting line, to keep these men in good physical condition, and if sick or wounded, to make them fit and ready for fighting as soon as possible. In attaining these objects every effort must be made to interfere in no way with military operations.

ORGANIZATION AND ADMINISTRATION OF THE BRITISH ARMY, WITH ESPECIAL REFERENCE TO THE MEDICAL SERVICES.

Each Army in the field is composed of a varying number of Corps. Each of these Corps contains a varying number of Divisions. Each Division consists of three Brigades and divisional troops. An Infantry Brigade contains four Battalions. The Administrative Medical Officers of the above formations are as follows:

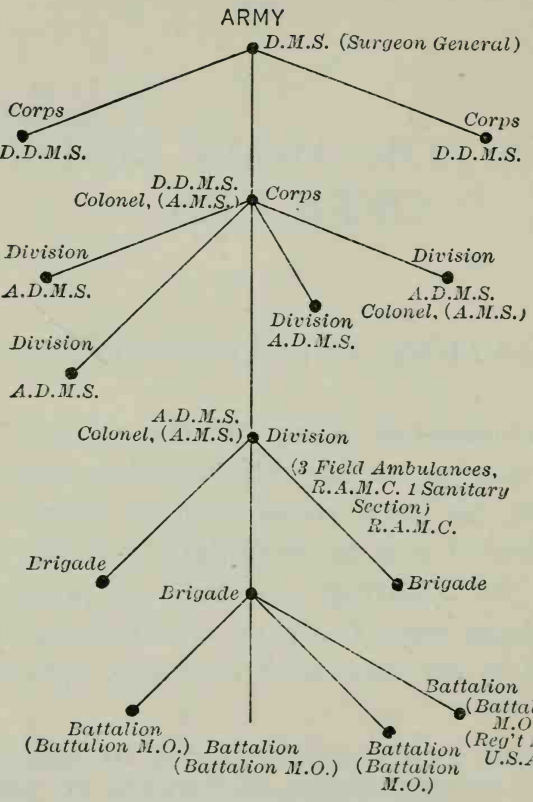

FIG. 1

CHIEF SURGEONS IN BRITISH ARMY.

D. M. S.	=	Director of Medical Service.
D. D. M. S.	=	Deputy Director of Medical Service.
A. D. M. S.	=	Assistant Director of Medical Service.
A. M. S.	=	Army Medical Service.
M. O.	=	Medical Officer.
R. A. M. C.	=	Royal Army Medical Corps.

With the headquarters of each Army is a Surgeon-General, with the rank of Major-General. He is

styled the Director of Medical Services and has a staff of officers and clerks.

With each Corps headquarters is a Colonel of the Army Medical Service, designated a Deputy Director of Medical Service, with an assistant, usually a Major of the Royal Army Medical Corps.

A Colonel of the Army Medical Service is with the headquarters of each Division, of which Division he is the Assistant Director of Medical Services. He has an assistant, usually a Senior Captain or Major in the Royal Army Medical Corps, and a staff of clerks.

The Director of Medical Services of an Army and the Deputy Director of Medical Services of a Corps are responsible for the sanitary organization in their respective formations, for dealing with epidemics, for the provision of motor ambulance convoys, medical and surgical supplies, for the collection and evacuation of sick and wounded, the distribution and situation of Casualty Clearing Stations, and numerous other matters.

The Assistant Director of Medical Services of a Division commands the Royal Army Medical Corps personnel in that Division, *i. e.*, three Field Ambulances, one Sanitary Section, and also the Royal Army Medical Corps Officers and other ranks attached to Battalions, Brigades, etc.

He is the responsible advisor to the General Officer commanding the Division, with reference

to the sanitary condition of the area in which the Division is situated, the hygienic welfare of the troops, and sanitary organization generally. He is responsible for all arrangements for the collection and evacuation of sick and wounded.

In modern warfare the number of casualties is so immense and the difficulties attendant on their collection and evacuation are so great that very considerable forethought and careful organization on the part of the A. D. M. S. are necessary, in order to insure satisfactory results. It will manifestly be impossible for the A. D. M. S. to make adequate arrangements unless he is kept informed by the Division Headquarters' Staff as to dispositions and impending operations. Accordingly a provisional draft of the Divisional Operation Orders is sent by the Headquarters' Staff to the A. D. M. S., and he is asked to write a draft for insertion in these orders. He does this, and then he issues his own (R. A. M. C.) Operation Orders, which are circulated to the officers commanding Field Ambulances and other officers concerned, a copy being sent to the Divisional Headquarters' Staff for their information and approval. In these Orders he indicates the position which the various Field Ambulances will occupy, the area over which they will operate, the situation of Dressing Stations, the routes along which the ambulance wagons will ply, etc.

The A. D. M. S. must, so far as possible, cultivate the power of prevision. He must foresee all possibilities and be prepared for them. To quote a saying of Monsieur Pasteur, "Fortune only favors the man who is prepared."

The point which I would strongly impress is, that the A. D. M. S. must keep in the closest possible touch with the Divisional Headquarters Staff, and should keep himself accurately informed as to impending operations or changes in existing operations.

MEDICAL UNITS.—The Medical Units with each Division are three Field Ambulances and one Sanitary Section. From the Division backward toward the base are the motor ambulance convoys, casualty clearing stations, hospital trains, stationary and general hospitals, and hospital ships (Figs. 2 and 3). There are also Advance and Base Depots of Medical Stores and Convalescent Camps.

These Units will be dealt with later when considering the collection and evacuation of sick and wounded.

See Medical Units, United States Army (Fig. 3).

THE RELATION TO OTHER BRANCHES OF THE ARMY.—The *Medical Service* coöperates with the other branches of the *Army* and obtains its supplies in the following manner:

Ordnance Department.—Such hospital equipment as bedsteads, tables, crockery, rugs, etc., is obtained

from the Ordnance Department. A Deputy Assistant Director of Ordnance Service is with the Head-

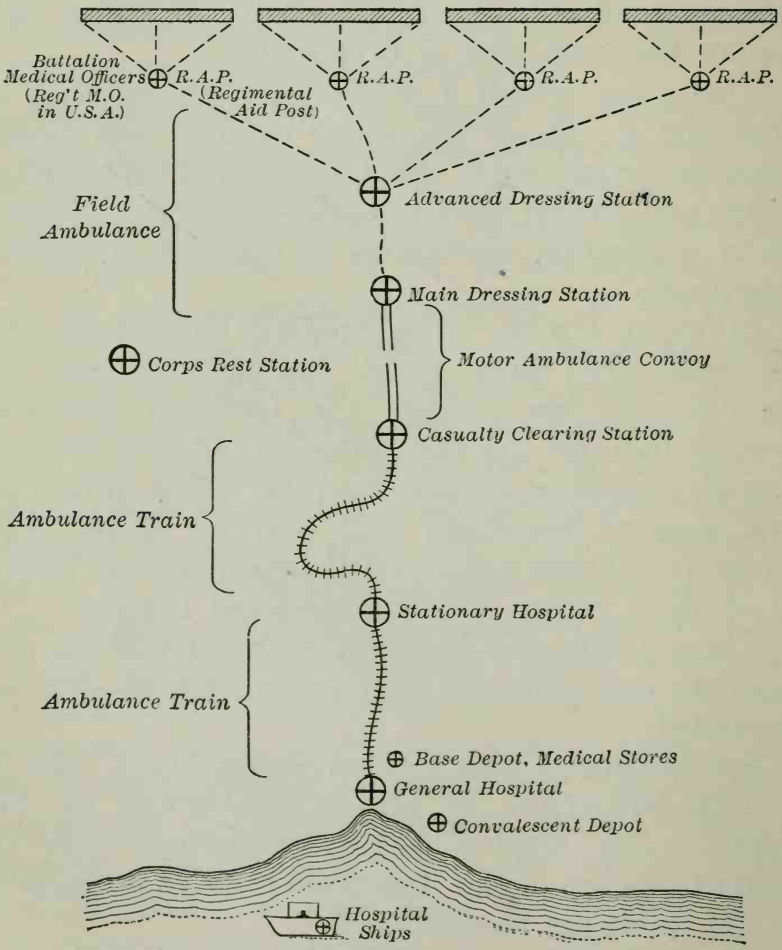

FIG. 2

quarters of each Division. There are numerous depots of Ordnance stores in the area of operation, and supplies can be quickly obtained.

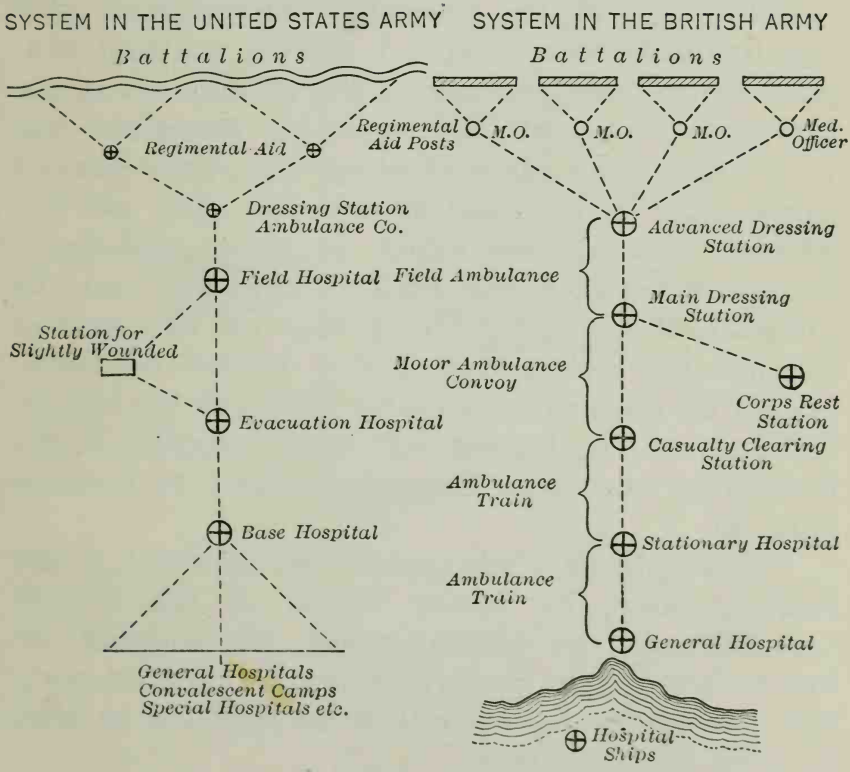

FIG. 3

Army Service Corps.—Medical comforts, that is, such articles as brandy, champagne, port wine, arrow-root, condensed milk, and beef tea, are

obtained as required from the Supply branch of the Army Service Corps, and the supply of such articles in the Field Ambulances, Casualty Clearing Stations, and Hospitals is thus replenished as required.

Before leaving the subject of our relations with the Army Service Corps, I should mention that prior to this war and during the earlier part of the campaign our work of evacuating casualties was very much more dependent on the Army Service Corps than is the case at present. The pre-war scheme provided no motor or other ambulance transport between the Field Ambulance and the railhead, the intention being that on this part of the line the sick and wounded should be transported by means of the motor lorries of the Supply Column, which, having left their supplies in the front area were now returning empty to railhead (Fig. 4).

The supplies are conveyed from railhead to the refilling point by motor lorries of the Supply Column. At the refilling point, the supplies are handed over to the Supply Section (horse transport) and the motor lorries return to railhead to load up with fresh supplies.

The utilization of the motor lorries for sick and wounded could not work satisfactorily under modern conditions, but at the same time I would mention that the lorries of the Supply Column did extraordinarily good work during the early part of

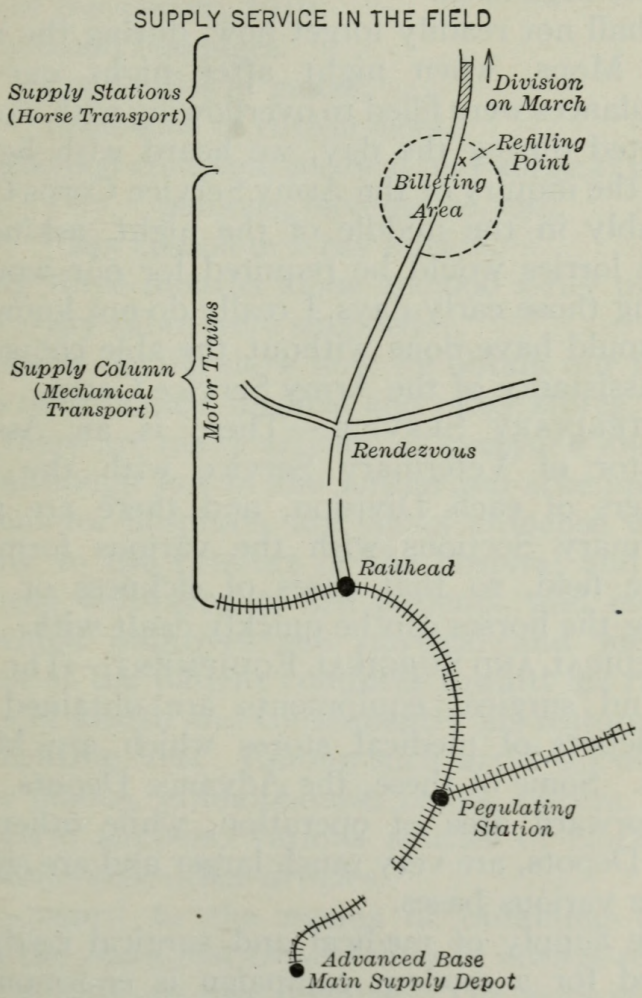
SUPPLY SERVICE IN THE FIELD
Supply Stations
(Horse Transport)
Supply Column
(Mechanical
Transport)
Motor Trains
Division
on March
Refilling
Point
Billeting
Area
Rendezvous
Railhead
Regulating
Station
Advanced Base
Main Supply Depot

FIG. 4

the war, before the motor ambulance convoys had become organized.

I shall not readily forget how, during the retreat from Mons, when night after night our Field Ambulances were filled to overflowing with wounded collected during the day, we heard with heartfelt relief the inquiry of the Army Service Corps Officer, probably in the middle of the night, asking how many lorries would be required for our wounded. During those early days, I really do not know what we should have done without the able coöperation and assistance of the Army Service Corps.

VETERINARY SERVICE.—There is an Assistant Director of Veterinary Service with the Headquarters of each Division, and there are mobile Veterinary Sections with the various formations in the field, so that cases of sickness or injury among the horses can be quickly dealt with.

MEDICAL AND SURGICAL EQUIPMENT.—The medical and surgical equipments are obtained from the depots of medical stores which are Medical Units. Some of these, the Advance Depots, are in the forward area of operation, while others, the Base Depots, are very much larger and are situated at the various bases.

The supply of medical and surgical equipment needed for a modern campaign is enormous. It may possibly be of interest if I mention a few details as to the supplies which we have furnished

to our Armies from the beginning of the war until the end of November, 1916:

37,500,000 bandages.
35,000 miles of gauze.
3,000 tons of cotton wool.
100,000 complete medical and surgical companions, haversacks, etc.
243 complete *x*-ray outfits.

During three months alone 200,000 *x*-ray plates and 600 *x*-ray tubes were supplied.

The above details show how we obtain our large supplies of ordnance, medical and other stores.

Now there are many articles, as everyone knows, which, although not in the authorized schedule of equipment for hospitals, are yet of immense value in adding to the comfort of the hospital and the consequent well-being of the patients, and everything which improves the physical and mental condition of the patient conduces toward his rapid recovery of health and consequently his restoration to the fighting line. Among such articles I might mention pianos, gramophones, books, papers, pictures, warm slippers, various articles of clothing, and innumerable other articles.

With regard to the means of obtaining such articles, the *Red Cross Organization* is always ready to help us in every way possible. The work of this Society in assisting the Medical Service in time of war is of the utmost value.

The furnishing of motor ambulance cars during the present war has been largely carried out by this Society.

WASTAGE IN WAR.—The ordinary daily wastage which occurs through the year with every army in the field, from sickness, apart from wounds, was, prior to this war, laid down as being 0.3 per cent., that is, three men in every thousand were daily sent down the lines of communication through sickness. An average of 70 per cent. of an army becomes incapacitated during the first year of a war, that is, during the first twelve months 14,000 per division of 20,000 will be passed back along the line. While the above percentages may be accepted as generally correct, yet during the present campaign the normal daily wastage from sickness has usually been below the figures quoted. The general health of the British Army has been uniformly good and our average wastage from sickness has been distinctly low.

In regard to this daily wastage from sickness we have noticed that when a Division is occupying the front line trenches there is comparatively little wastage from sickness, yet when this same Division is brought back into reserve the daily sick-rate rises immediately, the reason being that men are unwilling to report sick while they are in the front line and will defer doing so until their Battalion is brought into rest in the back area,

when they take the opportunity of bringing their ailments to notice. There is a general feeling among the men against reporting sick if they can avoid it while they are in the trenches.

BATTLE CASUALTIES.—In a modern battle from 5 to 25 per cent. of casualties may be expected. The proportion of killed to wounded is usually about one to four.

Regarding the wounded, the following may be taken as approximate figures as regards transportation:

20 per cent. will be able to walk.
35 per cent. will require sitting accommodation.
45 per cent. will require lying down accommodation.

60 to 75 per cent. of the total wounded will probably be eventually returned to the fighting line.

In modern trench warfare, about 75 per cent. of the wounds are produced by shell-fire and 20 per cent. by rifle and machine-gun fire, this proportion, of course, varying with the nature of the action.

In 100 wounded there will be:

10 to 20 head wounds.
5 to 10 chest wounds.
6 abdominal wounds.
60 wounds of extremities.
(20 to 25 of these last will be fractures.)

We shall now consider the means by which these sick and wounded are dealt with.

The Medical Services from front to base are as follows (Fig. 3).

1. *Medical Establishment with Units.* — Each Infantry Battalion is furnished with one Medical Officer, one Corporal and four men of the R. A. M. C. The Battalion furnishes a Sanitary detachment of one non-commissioned officer and eight men, also sixteen stretcher-bearers, with eight stretchers. (The "stretcher" is almost exactly similar in pattern to the "litter" of the United States Army.)

The above number of regimental stretcher-bearers is frequently increased before an action is expected.

2. *Field Ambulances.*—Each Field Ambulance is composed as follows:

9 Medical Officers.
1 Quartermaster.
241 Other ranks.

Ambulance transport:

7 Motor ambulance cars.
3 Horse ambulance wagons.
Various horse carts and wagons for cartage of equipment and stores.
51 Horses.
12 Bell tents.
3 Operating tents.

The Field Ambulance is divided into the Bearer and the Tent Division.

The Bearer Division consists of three Medical Officers, some non-commissioned officers and one hundred and eight stretcher-bearers, forming, according to Regulation, eighteen stretcher squads, each squad consisting of six bearers with one stretcher. In practice, however, it is usually found preferable to form twenty-seven squads, each consisting of four men with a stretcher.

The Tent Division consists of six Medical Officers and a staff of non-commissioned officers and men trained in nursing, cooking, and clerical duties. This Division forms the Advance or Main Dressing Station or stations, as may be required.

3. *Motor Ambulance Convoys.*—Composition is as follows:

4 Officers R. A. M. C. (The Senior in command.)
18 Other ranks R. A. M. C.
4 Officers and 146 other ranks Army Service Corps (attached).
50 Motor ambulance cars.
4 Touring cars.
7 Motor cycles.
4 Lorries, including one workshop lorry for repairs.

4. *Casualty Clearing Station.*

7 Medical Officers.
91 Other ranks.
Sisters and Nurses.

5. *Ambulance Trains.*
   3 Medical Officers.
   3 Nursing Sisters.
   47 Other ranks.

6. *Stationary and General Hospitals.* — Large, fully equipped Units. The Staff varies according to the size of the Unit. The Stationary Hospital usually accommodates 400 and the General Hospital, 1040 patients; but both are capable of very considerable expansion. They are usually situated in buildings, but may be hutted or tented, if buildings are not available.

7. *Hospital Ships.*—Staff varies according to size.

DUTIES OF THE MEDICAL OFFICER IN CHARGE OF A BATTALION.

When no very active operations are in progress, the Battalion Medical Officer sees the daily sick every morning, and when possible, he has a sick parade again in the evening. Minor maladies which do not require hospital treatment are marked "medicine and duty," which means that the man receives treatment but continues doing his duty. Others are marked "medicine, excused duty." Such a case receives treatment and is excused from duty until again seen at the next sick parade. Cases which are of a more serious nature are, if considered advisable, marked "hospital" and transferred to the Field Ambulance for further treatment. The

Field Ambulance, during such a period as we are now considering, sends one or more of its ambulance cars around the front area daily, to collect such cases as have been marked "hospital."

On arrival at the Field Ambulance, cases will be dealt with according to their nature. Some will be transferred forthwith to the "Corps Main Dressing Station," which is, in reality, a hutted or tented hospital in an advance position, administered by one of the Field Ambulance detailed for the purpose by the Deputy Director of Medical Services of the Corps.

After detention and treatment here, the cases may be sent back to their Units for duty, or they may be transferred to the "Corps Rest Station"[1] for convalescence, or, if necessitating a longer period of treatment, they may be transferred farther back to the Casualty Clearing Station.

By this means a considerable amount of wastage is avoided, only the more serious cases finding their way as far back as the Casualty Clearing Station.

We must remember that the whole object of the Medical Service is to provide men for the fighting line, to keep them fit, and if sick or wounded, to

[1]The Corps Rest Station, which is in reality a small convalescent camp in the forward area, is administered by a field ambulance, or part of a field ambulance, detailed for the purpose by the D. D. M. S. of the Corps.

make them ready for further fighting as soon as possible.

If all cases, including those of a slight nature, were sent down to the Base, there would be considerable delay in getting them back to the fighting line, consequently much avoidable wastage would take place.

The Battalion Medical Officer should keep a daily diary, in which he notes details as to casualties, number of sick, sanitary recommendations, etc.

He is furnished with equipment as follows:

1 surgical haversack.
1 medical companion.
1 pair field medical panniers, containing drugs, appliances, etc.

He also has his own pocket case of instruments. The equipment is complete and fulfils requirements. It is replenished, when necessary, from the nearest Field Ambulance. Such articles as splints, shell dressings, hot-water bottles, etc., can be readily obtained from the Advance Dressing Station of the Field Ambulance, as required.

DURING ACTION.—In the clearing of battle casualties the Battalion Medical Officer establishes one or more Regimental Aid Posts in the rear of his Battalion. Such Aid Posts are in a sheltered position, usually in a dug-out. *Where* should be the position of the Battalion Medical Officer while his Battalion is in the front line trenches? He should

be with, or close to the Commanding Officer of the Battalion (at Battalion Headquarters).

The advantages of such a position are obvious. The Commanding Officer is in communication by telephone with all the different sections of the trenches, consequently the Medical Officer, if close to him, can get immediate information as to casualties in any particular spot; and everyone in the Battalion knows where the Medical Officer is to be found.

It is advisable that he should have the dug-out for his Regimental Aid Post in a position near Battalion Headquarters and also near the main communication trench, between the front trenches and the rear. By this means the wounded can be readily taken back by the stretcher-bearers to the Advance Dressing Station.

Now we will suppose that the Battalion is ordered to attack. What should the Battalion Medical Officer do? This is a point on which some difference of opinion exists, but the following is my idea as to his correct method of procedure:

He should, so far as possible, keep near the Commanding Officer and move forward with him. If the attack is successful there will be a certain number of wounded in what was "no man's land," that is, the ground between the two trenches which has now been taken by his Battalion.

The Medical Officer should direct such of these

casualties as are able to walk to go back, taking shelter as far as possible, until they meet the stretcher-bearers of the Field Ambulance Bearer Division, who are coming up from behind. Those wounded who are unable to move should be placed in shelter in shell craters, in trenches, etc., and First Aid performed as rapidly as possible. They will be attended to and removed by the Field Ambulance stretcher-bearers on arrival.

The Medical Officer should not delay here. He must, at all costs, keep in touch with his Battalion and move forward with it. His presence in the newly won enemy's trenches will be of immense moral value and he can immediately set about establishing a Regimental Aid Post, improvising shelters for the wounded, attending to fresh casualties as they occur, etc. He should take every opportunity of keeping in touch by telephone or messenger with the Field Ambulance Bearer Division, which will now, under a fairly heavy shell fire, be clearing the wounded from the area through which he has just passed. Much can be done in this way by sending back short written messages by the wounded who are able to walk.

The above is only a general outline of what frequently happens during an attack. The actual procedure must, of course, vary with the military exigencies of the moment.

The general rules which I should lay down for the guidance of the Battalion Medical Officer would be somewhat as follows:

1. Keep as much as possible near the officer commanding the Battalion. Your position will then be known and you will be able to keep yourself informed as to any change in the military situation which may be impending.

2. At all costs, keep in touch with your Battalion. Go forward with it, rather than backward with the wounded.

3. Endeavor, by all possible means, to keep the Officers of the Field Ambulance Bearer Division informed as to the number and situation of casualties, your own position, etc.

4. Keep cheerful. Your mental attitude will have a considerable moral effect on the men.

As regards treatment of casualties in the front line, this is necessarily almost altogether in the nature of First Aid and the placing of the wounded men in the nearest position of shelter. Immediate treatment will consist of:

(*a*) Arrest of hemorrhage.

(*b*) Application of first field dressing.

(*c*) Relieving of pain, *e. g.*, administration of morphin.

(*d*) Application of supports to fractured limbs.

Every officer and man in the Army is supplied

with a "First Field Dressing,"[1] which is carried in a special pocket provided for the purpose in the skirt of the jacket. Fractures should be immobilized by means of rifle splints, short wooden splints, slings, etc. Care should be taken that bandages are not tied too tightly. A tourniquet should not be applied unless absolutely necessary, in which case, a special note should be made on the tally for the guidance of the next officer who sees the case.

THE REGIMENTAL AID POST.

This should be near Battalion Headquarters for the reasons already given. Its position will probably be from a quarter- to a half-mile behind the front line trenches and close to the communication trench.

[1] FIRST FIELD DRESSING.—On active service every officer and soldier carries a "First Field Dressing" in a pocket in the right side in the skirt of the jacket.

At present the first field dressing is composed as follows:

(*a*) Iodin ampoule in cardboard tube. The ampoule contains 30 m. of weak tincture of iodin, B. P. (The ampoule of iodin is now being omitted from the first field dressing.)

(*b*) Two small dressings, each complete in itself.

The above are enclosed in a brown holland cover with instructions for use on the outside. Each single dressing consists of:

1. A loose woven cotton bandage, $2\frac{1}{2}$ yds. long by $2\frac{1}{2}$ in. wide. Dyed a khaki color.
2. A piece of bleached cotton gauze, 36 in. by 23 in. folded into a pad 6 in. by $3\frac{1}{2}$ in. Stitched to the bandage 18 inches from one end. The gauze pad contains 2 or 3 per cent. by weight of double cyanide of zinc mercury and is tinted with rosanilin.

The bandage and gauze are cemented in a water-proof jaconet covering.

3. A safety-pin in a waxed paper.

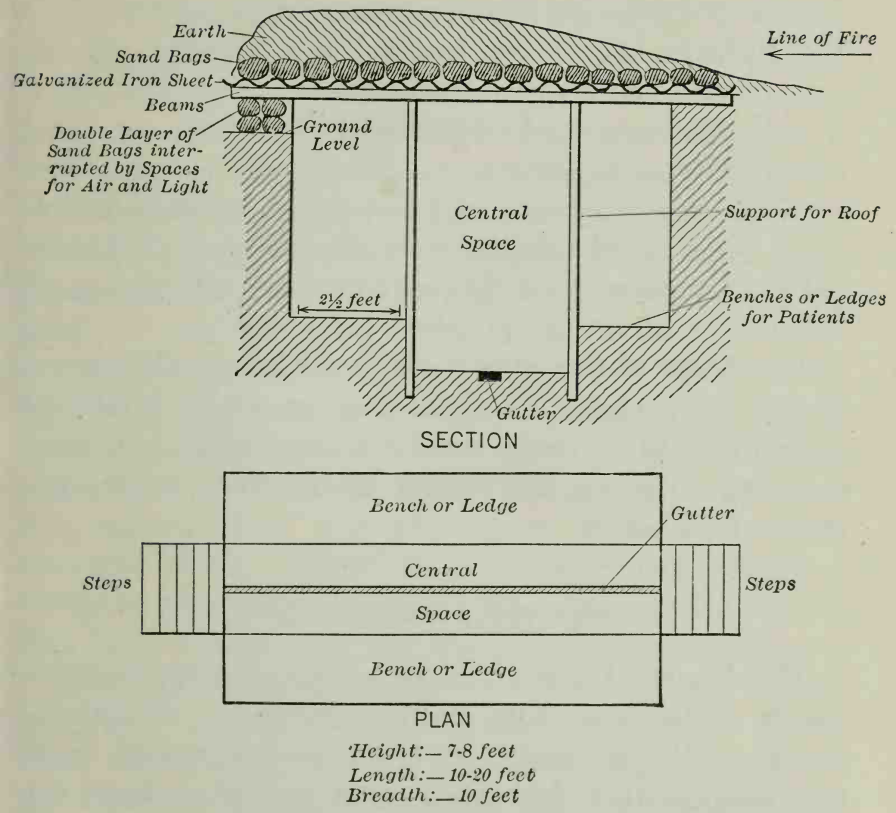

FIG. 5

EQUIPMENT.—

1 pair of Field Medical Panniers.
1 water bottle.
1 field medical companion.
1 surgical haversack.
1 haversack of shell dressings (obtained from the Field Ambulance).

Apparatus for heating water, milk, etc.
Splints (obtained from Field Ambulance or made as required).
Extra supply of First Field Dressings.
Antitetanic serum.
Thomas's splints and hot-water bottles, which can be obtained from the Field Ambulance.

Fig. 5 represents a dug-out used as a Regimental Aid Post which may possibly be of service.

The floor of the dug-out should be gently sloped at one end, where a hole is dug, in which is placed an empty tin to catch water, a gutter about 6 in. x 6 in. is laid along the center of the floor, terminating at this hole.

THE FIELD AMBULANCE.

The Bearer Division of this Unit maintains close touch with the Regimental Medical Establishments, collects casualties from the field and from the Regimental Aid Post and conveys them on stretchers to the Advance Dressing Station (Fig. 2). The ambulance wagons of the Field Ambulance are brought as far forward as possible, in order to relieve the stretcher-bearers and make their "carry" as short as may be feasible. It may be even possible, if roads are practicable, to get the wagons forward to suitable points considerably in front of the Advance Dressing Station.

Casualties thus collected are taken back, either direct to the Advance Dressing Station of the Field Ambulance or to the nearest point to which the horse or motor ambulance wagons can approach. In the latter case the bearers expeditiously load the wounded men on the wagons, and having taken a corresponding number of empty stretchers from these vehicles, return at once to the collecting area.

On arrival at the Advance Dressing Station, the wounded are further treated. Dressings, when necessary, are reapplied, bandages and immobilizing apparatus may require readjustment, and the cases are sorted into groups, those with abdominal wounds being dispatched without the slightest delay to the special casualty clearing station, which has been detailed for the reception of such cases.

Cases of a slighter nature will be detained or sent to the "Corps Main Dressing Station." Every case of wound, no matter how slight, receives an injection of five hundred units of antitetanic serum, and the fact of this having been done is noted on his tally, so that it is practically impossible for the wounded to get farther back than the Casualty Clearing Station without having received an injection.

On reaching the Base all cases of wounds of a serious nature receive a second similar injection.

ORGANIZATION OF A DRESSING STATION.

An Advance Dressing Station may possibly be in a large dug-out. The Main Dressing Station will probably be in a building. In the latter case it is necessary to have a clear, wide entrance and exit, in order that ambulance vehicles may drive in, unload their cases and drive out, without any delay and without obstruction being caused to the vehicles behind.

The Dressing Station should be close to a good road leading from the area of operations in front to the Casualty Clearing Station in the rear. Wherever situated, the personnel should be divided into sections as follows:

RECEIVING, RECORDING AND CLASSIFYING.—In this section will be noted the names, nature of wounds, etc. of all cases, on admission, and the cases will be sorted into different classes, according to the nature and extent of their injuries.

NURSING.—Here the more serious cases are attended to and any absolutely necessary operations are performed. Few operations other than those required for the arrest of hemorrhage and for tracheotomy should be performed at the Dressing Station.

KITCHEN.—Hot drinks, soup, milk, etc., are here prepared for the wounded.

PACK STORE.—Here equipment, arms, ammunition, etc., are attended to.

If buildings are not available, it may be necessary to use tents.

MOTOR AMBULANCE CONVOYS.

The means of transport between the Field Ambulance and the Casualty Clearing Station is furnished by the motor ambulance convoy. One or more of these convoys are detailed by the D. M. S. of the Army or the D. D. M. S. of the Corps to whichever area requires their services.

By means of the motor ambulance convoy, enormous numbers of wounded men can be brought from the Field Ambulance to the Casualty Clearing Station in a comparatively short time.

CASUALTY CLEARING STATIONS.

On arriving at the Casualty Clearing Station, the cases are further dealt with. A vast amount of operating is performed in these Units, and at periods when heavy casualties are occurring it will be found necessary to considerably augment the normal staff of seven Medical Officers.

Matters will frequently be so organized that one Casualty Clearing Station is set apart for the reception and treatment of abdominal or head wounds, all such cases being dispatched to this Special Casualty Clearing Station as soon as possible.

Those cases which, after field dressing or operation, are found fit to travel, are sent down by Hospital Train to the large hospitals, Stationary and General, on the lines of communication and at the Base, where large numbers of wounded arrive within twenty-four hours of having been injured. At these hospitals they are kept for a variable length of time.

The above represents the mode of procedure during normal conditions. It is, of course, subject to modification, *e. g.*, in time of stress cases may be sent from the advanced dressing station direct to the ambulance trains, or they may be sent direct from the front line to the Casualty Clearing Station, etc.

STATIONARY AND GENERAL HOSPITALS.

In these Units we find the best of modern instruments and equipment, *x*-ray installations, bacteriological laboratories, etc.

When sufficiently recovered from wounds or sickness, patients are transferred to Convalescent Depots from the hospital. These Convalescent Depots are capable of accommodating 2000 or more men. They are large hutted or tented camps, with recreation rooms and libraries, cricket and foot-ball fields, etc. They are administered by R. A. M. C. Officers, and the men do graduated marches and exercises daily, under medical supervision.

When their health and strength are fully regained, they are drafted back again to the fighting line.

Such cases as require removal to England are transported from the General Hospital by hospital ship and, on arrival in England, are taken by hospital trains to various hospitals all over the British Isles, according as accommodation may be available; and from these, as they become convalescent, they are transferred to Convalescent Homes, or V. A. D. hospitals throughout the country.

These Convalescent Homes are frequently large private houses, loaned by their owners to the Government for the period of the war. They are administered by a lady, frequently the wife of an officer at the front, who looks after the catering, supplies, clothing, etc. She has under her a staff of nurses, cooks, etc. She receives from the Government a small allowance per head for each convalescent patient in the hospital, to cover the cost of feeding. With good management, these Homes are remarkably comfortable; and people living in the neighborhood render ready assistance in the way of providing transport, etc.

A local medical man visits the Home at frequent intervals, sees the patients, and decides which of these are fit to return to duty. When he decides that certain men are fit for discharge, these are transferred to depots, where they are examined by R. A. M. C. Officers, re-equipped, and returned to the fighting area.

WAR SURGERY.

THE experience of the present campaign as regards military surgery has, in many ways, proved disappointing. We had hoped for many years past that, with the advance of asepsis, the improvement in antiseptic methods and our better methods generally for the treatment of wounds, there would have been effected a great improvement in their healing and that sepsis, in future wars, would not be a serious factor. Unfortunately, the result has not by any means justified our hopes, and sepsis has proved to be a very serious and general complication of almost every class of wounds.

The cause of this is probably the extremely polluted condition of the soil in the fighting area. The ground throughout the north of France and Belgium has been extensively cultivated and heavily manured for many years and is consequently extremely rich in organisms of all sorts. The air is usually heavily laden with dust as a result of the almost constant heavy shell fire, and consequently, the wound is almost invariably extensively infected as soon as inflicted; if not so infected at the time, it very probably becomes contaminated from mud or from the hands of the orderly,

stretcher-bearer or the patient himself during the application of the first field dressing.

Another cause for the very frequent occurrence of sepsis may, I think, be looked for in the very severe damage done to the tissues by the modern high-velocity missile, whether bullet, bomb or high-explosive shell. Even a very small fragment of a high-explosive shell tears and destroys the tissues through which it passes to a very much greater degree than one might expect, and consequently these destroyed and devitalized tissues form a very favorable nidus for the growth of any organisms which gain access to the wound.

In the following remarks I intend to limit myself almost entirely to any modifications which have been introduced or lessons which may have been learned, during the present campaign.

COLLAPSE AND SHOCK.

In every convoy of wounded will be found a certain number of men suffering from collapse and shock. This collapse is usually the result of:

(*a*) Hemorrhage.

(*b*) Exposure to cold, wet and hunger.

It is sometimes unavoidably the case that, owing to the large number of wounded and the heavy shell fire, it is difficult, if not impossible, to remove the wounded as rapidly as is desired.

(*c*) Injury to the viscera of abdomen or chest.

(*d*) Extensive shell wounds, more especially when one of the long bones is fractured. Fractures of the femur are always accompanied by a greater or less degree of shock.

(*e*) Multiple injuries.

One not infrequently sees a patient with fifteen to twenty wounds from bomb or high-explosive shell, and although no one of these wounds may in itself be serious, the total effect, as evidenced by shock, may be very severe.

(*f*) The effect of the long journey in an ambulance wagon, over bad roads, may produce a considerable amount of collapse, especially if any of the long bones are fractured.

TREATMENT OF COLLAPSE.—Rest the patient for an hour or two before dressing or examining him. If there is no sickness, give hot milk and soup and plenty of water in small quantities at a time. If food cannot be tolerated, give 10 to 20 ounces of warm saline + 10 per cent. glucose per rectum. If collapse is very severe or if due to hæmorrhage, give saline subcutaneously, intravenously, or continuously per rectum. Pituitary extract is of benefit in many cases.

TREATMENT OF WOUNDS.—As regards the treatment of wounds, I propose to deal with the matter under three headings:

1. Treatment at the field ambulance and casualty clearing station.

2. Treatment at the hospital base in France.

3. Treatment at the actual medical base in England.

1. *Treatment at the Field Ambulance and Casualty Clearing Station.*—(*a*) Give an injection of 500 units of antitetanic serum if this has not already been administered, and note the fact of the dosage on the patient's tally.

(*b*) Remove the first field dressing as soon as possible. It has usually been applied too tightly and, if not so in the first instance, the bandage quickly becomes too tight, owing to the swelling of the limb. The first field dressing should always be regarded as contaminated, as, even if not soiled by the hands of the man applying it, it has usually been placed on a dirty skin.

(*c*) Remove the patient from a dirty stretcher before exposing the wound.

It is hardly necessary to point out that medical officers should invariably wear rubber gloves and that both they and the orderlies must wear clean gowns.

(*d*) Place the limb upon a sterile jaconet, wash off all dirt and blood, cleanse the skin, remove any hopelessly torn or damaged tissues. If further action be necessary, anæsthetize the patient, enlarge and hold open the wound by retractors, wash out and drain all recesses, cleanse the track of the missile with a strip of gauze.

Furnish counter-opening for efficient drainage.

Insert large drainage tubes ($\frac{5}{8}$ inch to $\frac{7}{8}$ inch).

Do not suture the wound until the patient is under favorable conditions.

If an artery should be wounded, expose and ligature.

Do not plug a wound unless absolutely necessary. In such a case a special note to that effect should accompany the patient.

Hæmorrhage should always be arrested in the Field Ambulance, *i. e.*, in the Dressing Station.

Always remove a tourniquet at the earliest possible opportunity if one has been applied.

Antiseptics.—Antiseptics have proved rather disappointing. Any method which produces extensive coagula should be avoided Adequate drainage and mechanical cleansing form the first essential steps.

The following antiseptics have been found useful:

1. Two per cent. iodin in spirit. Not advisable for interior of large wounds.
2. Carbolic acid, 2.5 to 5 per cent.
3. Lysol, 1 dram to 1 pint.
4. Hydrogen peroxide, 5 to 10 volumes.
5. One per cent. watery solution of picric acid for multiple superficial wounds.
6. Flavin. This antiseptic is at present under trial.

The perfect antiseptic remains still to be found.

Summary.—1. Small, superficial wounds with no gross infection: 2 per cent. iodin. Dry antiseptic gauze.

2. Extensive Foul Wounds: Moist dressing. Gauze wetted with 1 in 60 carbolic solution +5 per cent. sodium chloride, or lysol, 1 dram to 1 pint. Free drainage. Dressing lightly applied. Never bandage a fractured limb except over a splint. Do not suture a wound. Many-tailed bandages are very useful, and, as a general rule, preferable to the roller variety.

Subsequent Treatment.—The above principles are still applicable, but more extensive procedure may be carried out on arrival of the patient at a base hospital.

(*a*) Thorough cleansing and removal of dead tissue.

(*b*) Excision of margin of skin and tissues from the track of the missile.

(*c*) Free incisions if necessary.

(*d*) Do *not* use gauze wicks.

(*e*) Powerful antiseptics are undesirable at this stage.

Special Methods.—(*a*) *Almroth Wright's Method.*—Many observers have favored this method. The main feature is the promotion of a free outflow of the lymph from the tissues into the wound. This "lymph lavage" is encouraged by the appliance of hypertonic solutions of sodium chloride. The best medium for this purpose is a 5 per cent. solution of sodium chloride with the addition of 0.5 per cent. citrate of soda to render the lymph incoagulable. In many cases it is advisable to add 2 per

cent. carbolic acid to the above. Gauze moistened by one of the above solutions should be lightly introduced into the open wound and a few layers applied to the surface. The dressing should be very lightly fixed in position.

(*b*) *Baths* and *continuous irrigation* have been extensively used and have proved efficacious in cases of deep, sloughing wounds.

(*c*) *Sunlight.*—When wounds have reached the stage of granulation, exposure to the sun and air hastens healing.

(*d*) *Hypochlorous Acid.* — The employment of this constituted a distinct advance in the treatment of wounds. A 5 per cent. solution of hypochlorous acid known as "Eusol" is prepared by shaking up 12.5 grams of boric acid powder and 12.5 grams of chloride of lime with one liter of water, allowing to stand for a few hours and then filtering. Continuous irrigation with this solution has had a marked effect on the healing of wounds.

(*e*) *Carrel-Dakin Treatment.*—I have left this method until the last because I consider it to be the most important and to have, under certain conditions, supplanted all other methods of treatment of wounds. This method has now been very largely adopted in France, and hospital trains and ships are now provided with the necessary appliances for carrying out the treatment during transit to England.

The principles are as follows:

1. The method aims at rendering the wound germ-free within a week or ten days.

2. Success depends on the closest attention to details and to antiseptic precautions.

3. An essential preliminary is the free excision of all infected or devitalized tissue and the removal of all foreign materials. All hemorrhage must be arrested. This preliminary mechanical procedure is followed by the introduction into and maintenance in the wound of the hyperchlorite solution in sufficient amount and strength to destroy any organisms present. This solution must, to insure success, flow into every corner of the wound. For this reason through-and-through drainage tubes must be avoided, as these will favor escape of the solution. In contact with the tissues the solution soon loses its bactericidal qualities and must therefore be renewed not less frequently than every two hours. This is effected by means of Carrel's appliance of a series of rubber tubes (Fig. 6). The solution employed is Dakin's. This must be neutral and should not be warmed or diluted. The fresher it is, the better, and it should not be kept longer than one week. Rubber tube, size No. 7, is employed. The distal end of each tube is closed by ligature. Numerous lateral small openings perforate the tube for two-thirds of the length which is buried in the wound. The tube may be bare or may

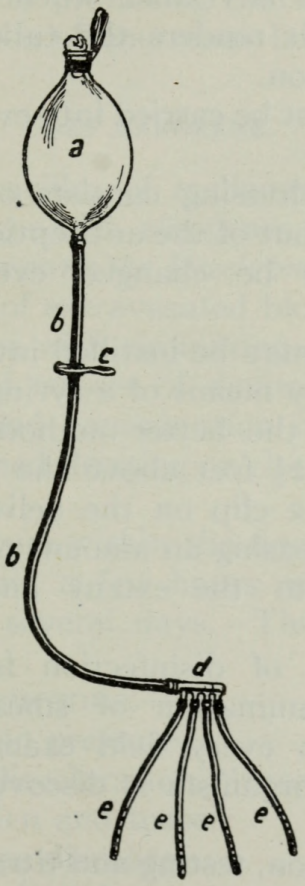

FIG. 6.—Apparatus for intermittent installation: *a*, reservoir (ampoule or flask holding a liter); *b*, irrigating tube with a diameter of 7 mm.; *c*, pinchcock (*Prince de Mohr*); *d*, distributing tube with four branches; *e*, conducting tubes. (Carrel and Dehelly.)

be surrounded by stitched gauze or cloth. This latter method is advisable, when cases are being transferred, as it renders the tubes less liable to shift their position.

The tubes must be carried into every recess of the wound.

The outside dressing consists of several layers of gauze wrung out of the antiseptic solution. This dressing should be changed every twenty-four hours.

The solution may be instilled into the wound by gravitation or by means of a syringe.

In a hospital the better method is to suspend a glass container $2\frac{1}{2}$ feet above the level of the bed and to relax the clip on the delivery tube every hour or two, releasing an amount of solution, varying according to the extent and depth of the wound.

The progress of disinfection is controlled by microscopic examination of smears every third day. When, in every field examined, not more than one microörganism is discovered, the wound may be closed.

The preparation, testing and titration of the solution must be carefully carried out by one who is thoroughly trained in the necessary technic.

There are various difficulties in the method of this treatment which will probably be overcome in the future by further experiments and experi-

ence. The results of the treatment up to date have been so very promising that perfection of the method should be of enormous benefit.

GAS GANGRENE.

Due to the bacillus of malignant edema or the Bacillus perfringens (B. aërogenes capsulatus).

Conditions Favoring the Development of Gangrene:

1. Retention of extravasated blood.
2. Interference with circulation.
3. Presence of masses of devitalized tissue.
4. Fracture and comminution of long bones.
5. Blood-stained dressing or clothes left in touch with the wound.

It usually occurs within the first three days. It may begin within a few hours or the onset may be delayed for several days. The onset is often extremely rapid.

SIGNS AND SYMPTOMS.—

1. Crackling on pressure.
2. Brownish discoloration, "bronzing."
3. Limb swollen and tense.
4. Foul gaseous discharge.
5. Offensive odor.
6. *Low* tension pulse. Hands and feet cold. Tongue dry and furred. Vomiting, hiccoughing. Temperature usually subnormal, never materially raised. A sudden fall to subnormal temperature is

of very serious prognostic significance. Death usually occurs within forty-eight hours of onset.

TREATMENT.—*Free* incisions. Removal of dead tissues. Thorough cleansing of the wound. Hydrogen peroxide. Drainage.

If hand or foot is warm do not, as a rule, amputate. If cold and insensitive, amputate at once, if the general condition of the patients permits.

TETANUS.

A very serious factor during the first two months of the war. Since the administration of a preventive dose of serum as soon as possible to every wounded man results have been excellent. Five hundred units are injected as early as possible and this dose is repeated on arrival at the base hospital in all cases of severe wounds.

TREATMENT.—Treatment after supervention of the dose: Initial intrathecal dose of 3000 units, repeated every second or third day. The risk of anaphylaxis is not serious.

WOUNDS OF THE LARGE BLOODVESSELS.

Primary ligature of the great trunks is rarely necessary and always undesirable.

ARTERIAL HEMATOMA.—The presence of diffuse pulsating swelling with a tendency to localization

and the formation of a "false aneurysm" which frequently becomes consolidated.

Operation may be called for on account of:

(*a*) Secondary hæmorrhage.
(*b*) Continuous increase in size.
(*c*) Secondary diffusion.
(*d*) Threatened gangrene from pressure.
(*e*) Threatened suppuration.

If operation is required, tie the artery above and below the injury.

ARTERIOVENOUS ANEURYSMS.—In the absence of any of the above-named complications, treat expectantly. If an operation is required, ligature the vessels immediately above and below the injury.

ANEURYSMAL VARICES.—Expectant treatment. These cases almost invariably do well.

FRACTURES.

GENERAL PRINCIPLES OF TREATMENT.—Tetanus antitoxin. Unrestricted drainage (if compound). Never bandage a fractured limb without first applying splint and a large quantity of cotton-wool. Triangular bandages are preferable to the roller variety.

TREATMENT OF WOUNDS.—(*a*) From rifle bullet. Entrance and exit wound small. No great extravasation of blood: Cleanse external wounds, dress and immobilize.

(*b*) From rifle bullet, entrance wound small, exit wound of "explosive" type: Explore under anæsthetic. Remove foreign bodies, blood clot and any *completely* detached fragments of bone. Expose wound completely, using retractors. Irrigate freely. Remove devitalized tissues. Excise edges of skin wound. Drain efficiently.

Be careful that no drainage tube lies in contact with the large vessels or traverses the defect in the bone. Do *not* use gauze wicks.

Continuous irrigation or Carrel-Dakin treatment, preferably the latter.

Fractures caused by shell or deflected (or reversed) bullets: Enlarge the wound. Thoroughly cleanse. Establish free drainage.

When only a wound of entrance exists, the skin must be freely incised, clots removed, and free counter-drainage supplied.

HUMERUS.—(*a*) At Field Ambulance and Casualty Clearing Stations: Short wooden splints, bandage arm to side. A modification of Thomas's splints, or Captain Mackenzie's splints form very efficient supports if available.

(*b*) At Base Hospital, fixation apparatus. Strohmeyer's cushion. Mackenzie's splints or Robert Jones's modification of Thomas's splints. Page's splints. The last-named splint is suitable for many cases. Avoid direct mechanical fixation, such as screws or plates.

FEMUR.—(*a* At the front and during transit: Anæsthetize. Apply adequate extension while under

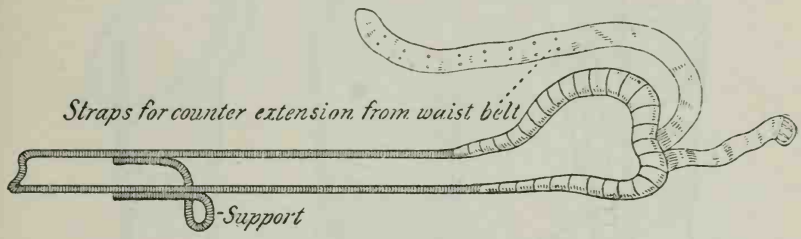

FIG. 7.—Captain Colin Mackenzie's splint for compound fracture of the humerus. (Described in the Lancet, March 25, 1916.)

anæsthetic and immobilize by means of Thomas's knee splint, with addition of short thigh splints if

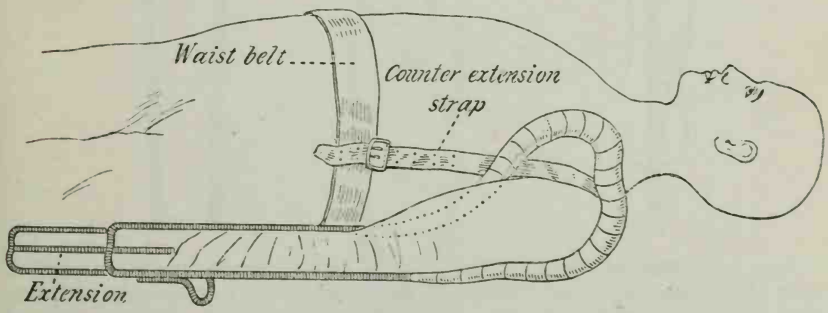

FIG. 8.—The advantage of this splint is that the counter-extension is obtained from a waist-belt, and consequently there is no pressure on the axilla.

necessary (Figs. 9, 10, 11 and 12). Page's splint is suitable for many cases during transit.

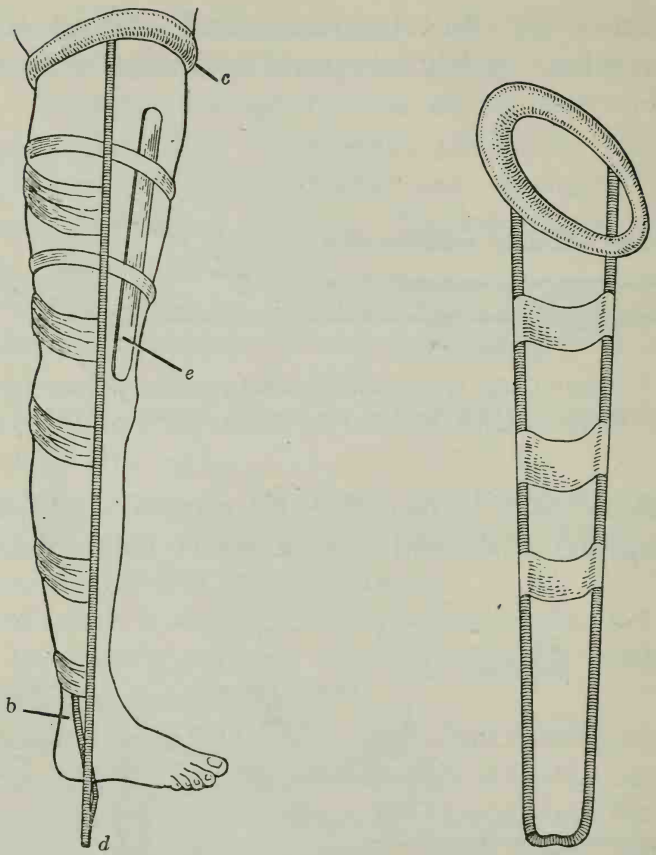

FIG. 9.—Thomas's knee splint applied for fractured femur, reinforced with short thigh splints. Mode of application: (*a*) Strapping of adhesive plaster is applied to the sides of limb, omitted, for the sake of clearness, in the figure. (*b*) At the lower end of extension strapping is attached a length of stout bandage. (*c*) The ring of splint is passed over the foot and up the limb until it rests firmly against the tuber ischii. (*d*) Pull the extensions tight, turn ends round each side bar and tie over lower end of splint. (*e*) If desired, local splints may be applied to the thigh. (*f*) The skin of the buttock should be attended to by the nurse every day, the skin being pressed, and a fresh portion drawn under the splint.

(*b*) At base: Constant extension. Thomas's splint or a modification, such as Cuthbert Wallace's.

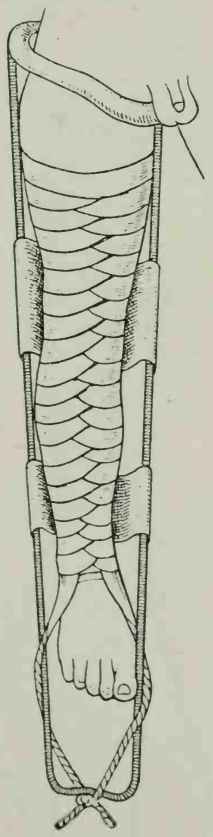

FIG. 10.—Knee splint in position, traction splint applied. (Jones.)

Robert Jones's abduction frame for fractures near the hip-joint (Figs. 13, 14, 15 and 16). Balkan splint (difficult to maintain sufficient extension).

Hodgen's wire suspension splint (needs constant attention and readjustment).

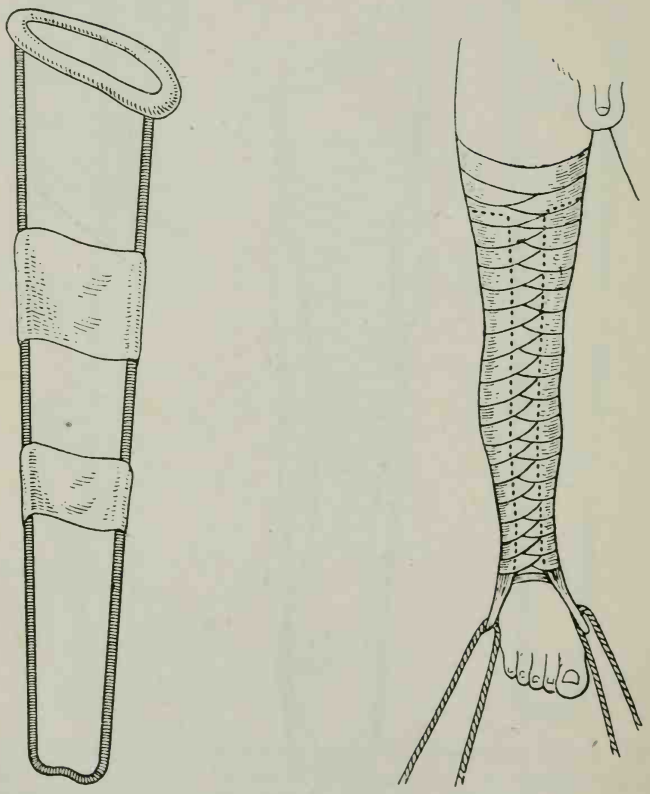

FIG. 11.—Strapping extensions applied to leg. Suspension slings to splint to support limb. (Jones.)

If a "Long Liston" splint is used a perineal band should not be employed during transit, as it

causes considerable swelling. Do *not* use wires, screws or plates.

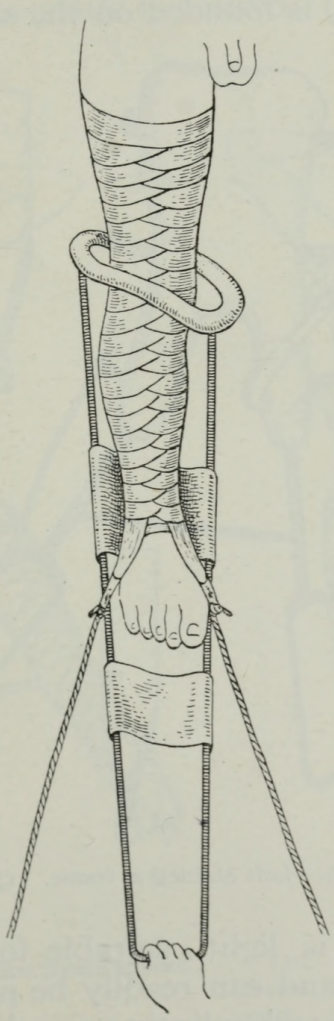

FIG. 12.—Introducing limb through ring of Thomas's knee splint. (Jones.)

For the very large majority of cases the Thomas splint is undoubtedly the most suitable. Page's splint (Fig. 17) is founded on the same principle as

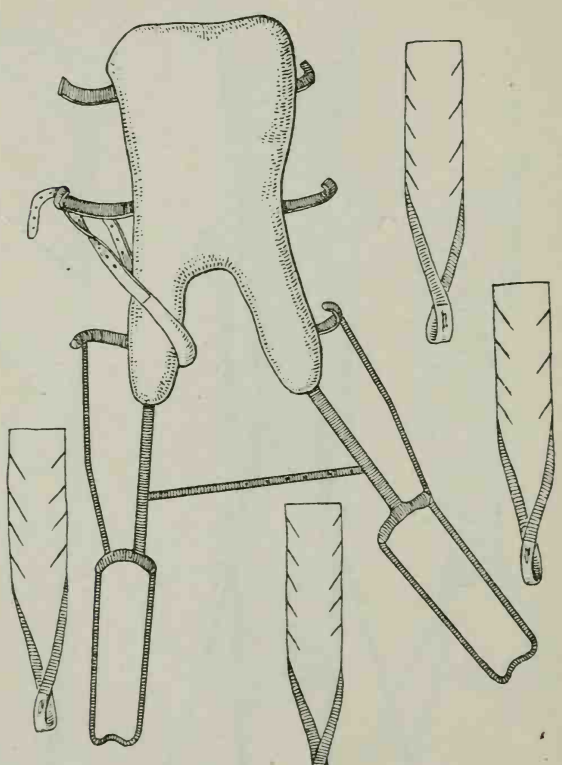

FIG. 13.—Left abduction frame. (Jones.)

Thomas's. It is light, suitable for cases during transportation and can readily be made up from a length of mild steel splinting supplied in the field

fracture box (Figs. 18, 19, 20 and 21). This splint can be bent into shape like a Hodgen if flexion at the hip- and knee-joints is desired.

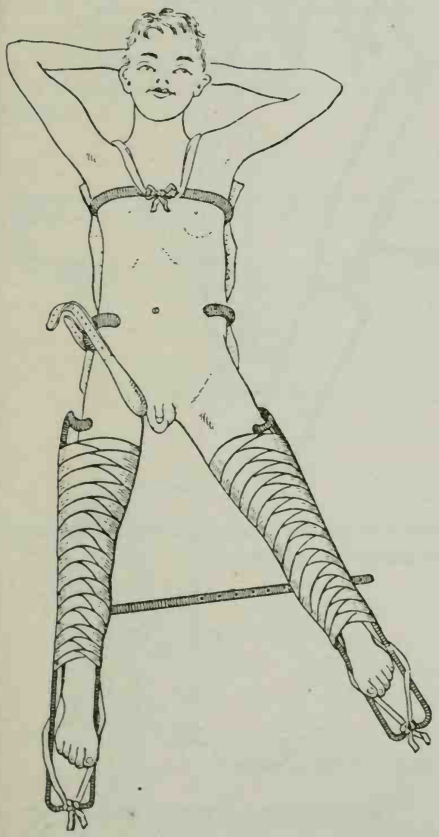

FIG. 14.—Left abduction frame applied. (Jones.)

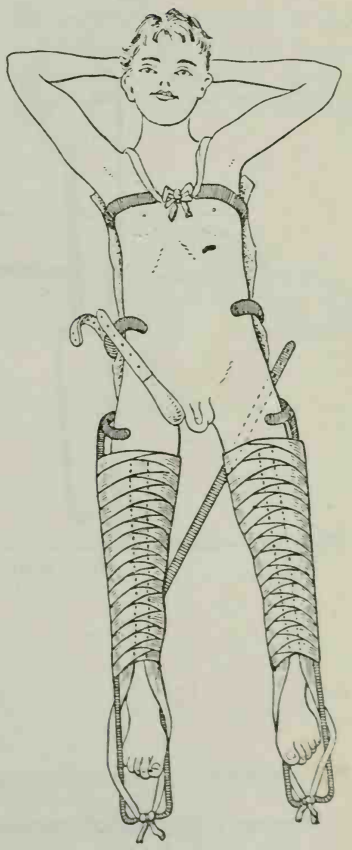

FIG. 15.—Left abduction frame; limbs parallel for transport. (Jones.)

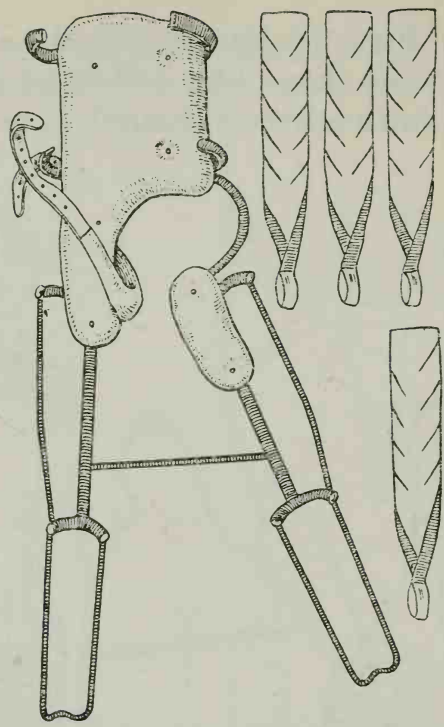

FIG. 16.—Modified abduction frame for pelvic wound, only to be used while wound discharges. (Jones.)

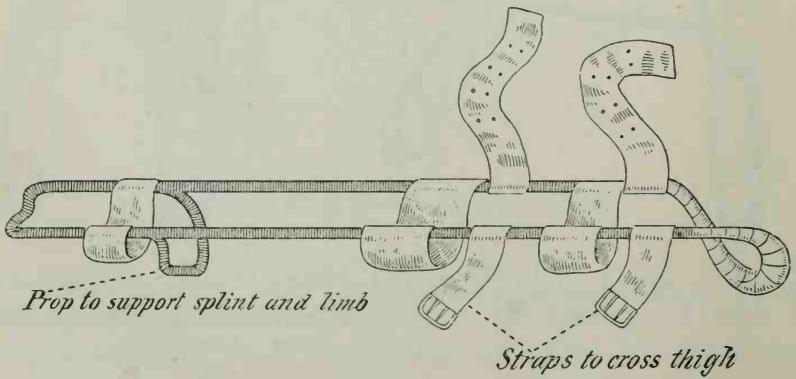

FIG. 17.—Page's thigh splint. This splint may be readily made up from the metal strips in the field fracture box.

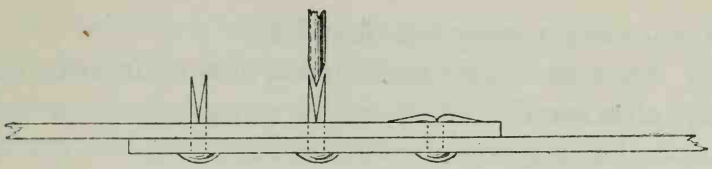

FIG. 18.—Material for making metal field splints as supplied in the field fracture box. Five-foot lengths of mild steel, $\frac{1}{2} \times \frac{1}{8}$ inch, holes $\frac{1}{8}$ inch in diameter are drilled at 1-inch intervals. Split steel rivets, $\frac{3}{4} \times \frac{1}{8}$ inch, are supplied for joining the lengths. Method of joining strips.

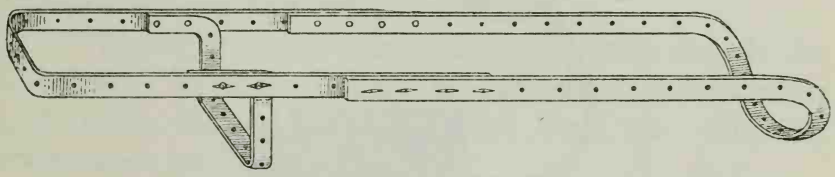

FIG. 19.—Modified Thomas's or Page's splint.

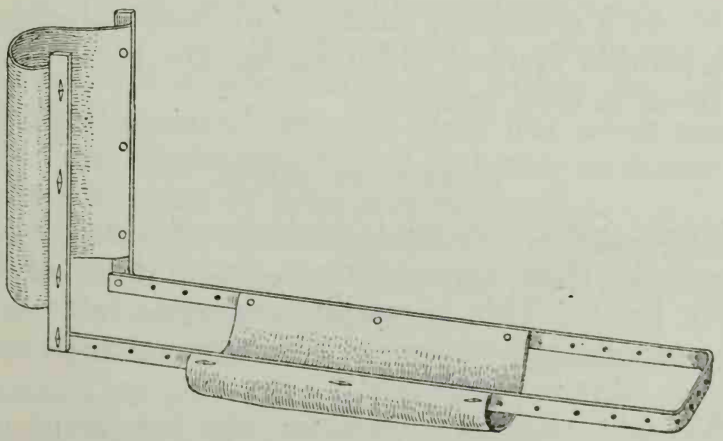

FIG. 20.—Hinged elbow splint.

Amputation may be called for:

(*a*) As a primary measure when a limb is hopelessly shattered; when it is gangrenous or when advanced gas gangrene has set in.

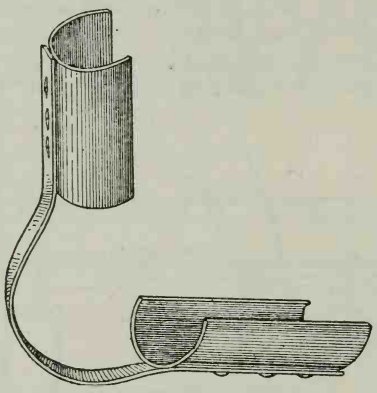

FIG. 21.—Interrupted elbow splint.

(*b*) As a secondary measure in cases running an unfavorable course. Indications are then similar to those in civil practice.

WOUNDS OF JOINTS.

KNEE-JOINT.—Wounds of the knee-joint are more serious in their consequences than those of any other joint. This is readily understandable when the complicated nature of the synovial membrane of this joint is considered.

We will therefore consider the treatment of a wound of the knee-joint and the same principles can

be adapted for a wound of any other joint, details being varied to suit particular requirements.

Types of Injury.—1. Cases of effusion without lodgment of projectile in the joint:

(*a*) Uncertain whether synovial cavity has been traversed or the membrane merely bruised.

(*b*) Synovial cavity traversed by a clean rifle bullet without injury to the bones.

(*c*) Clean perforation by a bullet of one of the bones forming the articulation.

In all the above, expectant treatment should be adopted. If there is any suspicion as to infection the joint should be aspirated and the effusion examined bacteriologically.

2. Cases in which the bullet has lodged:

(*a*) Within the synovial cavity.

(*b*) In one of the articular ends of bone.

Treatment.—(*a*) If the wound is small and not inflamed and a rifle bullet lies within the joint, leave until union of primary track has taken place.

(*b*) Free fragments of shell or bomb or distorted rifle bullets must be promptly removed.[1]

(*c*) Clean rifle bullets embedded in the articular ends and not interfering with the joint movement should be treated expectantly.

(*d*) Fragments of shell: Excise wound and track of missile. Remove foreign bodies.

[1] In all operations for the removal of foreign bodies, "follow the track of the missile" is a sound rule to be generally observed.

3. Cases in which the synovial cavity has been more or less widely opened: Treat wound carefully. Immobilize. Drainage may be required.

4. Cases in which serious comminution of the bone has occurred:

If of patella only, remove all completely loose fragments and suture the synovial membrane.

The majority of other cases require amputation, although there have been several good results following excision of the joint. The most scrupulous care will be necessary in insuring antisepsis when dealing with wounds of the knee-joint.

SUMMARY.—*Treatment at the Front.*—If the joint is extensively shattered and soiled and the main vessels and nerves are torn, amputate. Otherwise, disinfect skin, excise wound, remove visible or palpable foreign bodies, adequately immobilize the joint. No drainage tubing at this stage. Do *not* use a short splint. Thomas's knee splint is very efficacious.

Treatment at the Base.—(*a*) On admission, thoroughly shave and disinfect the skin. Immobilize the joint in position of slight flexion. X-ray skiagrams, preferably stereoscopic, should invariably be taken.

(*b*) If suppuration is present, open joint freely, remove all foreign material, excise wound. Do not use strong antiseptics. Carrel-Dakin treatment.

Treatment of Effusion.—High temperature during the early days does not necessarily indicate sepsis.

Aspirate and examine bacteriologically. Repeat aspiration if necessary. If effusion is sterile, rest, apply slight extension. If effusion is infected, aspirate freely, injecting formalin-glycerin (2 per cent.) iodoform ether (10 to 20 grains to the ounce), or ether, 2 or 3 drams. In either case extend the joint and repeat injection every two to six days. Keep immobilized.

If joint is actually open and septic, drain, apply Carrel-Dakin treatment. Attend carefully to the synovial pouches at the back of the joint.

HEAD INJURIES.

Do not be deceived by an apparently superficial wound. The inner table of the skull is frequently splintered and depressed in such cases. Before undertaking any operation, have a clear idea as to the object to be attained and the result to be expected.

OPERATIVE OBJECTIVES.—

1. Relief of symptoms of cerebral injury.
2. Prevention of future complications.
3. Cleansing of wound and removal of bone fragments and missiles.

1. *Relief of Symptoms of Cerebral Injury.*—(*a*) General symptoms, loss of consciousness, slowing of pulse, headache, blurring of optic disks (often quite an early symptom).

These symptoms are due to an increase of intracranial pressure. This rise of pressure within the first two or three days is due to traumatic edema, contusion and small hemorrhages.

(*b*) Local symptoms, paralysis, fits, alteration of the reflexes, sensory disturbances, visual defects.

These symptoms are due to the destruction of brain tissues, or the temporary functional disturbance by shock, local edema, etc.

Summary.—Operation is very seldom necessary on account of general or local cerebral symptoms.

2. *Prevention of Future Complications.*—Intracranial manipulations in the presence of a septic wound should be avoided, if possible.

Little is at present known as to the probability of future complications, such as Jacksonian epilepsy.

3. *Cleansing of the Wound.*—As a general rule the sooner such operation is undertaken, the better.

(*a*) Fissured fracture or depressed fracture of the inner table, without gross defect of the bone:

Cleanse, excise wound. Drain. If *x*-ray examination reveals depression, trephine.

(*b*) Depressed fracture of the "gutter" type:

Do not probe. Wait until concussion stage has passed before trephining. X-ray. If necessary, trephine and remove depressed fragments.

(*c*) Single penetrating wound of cranial cavity: Shave the whole head. Cleansing operation. X-ray.

(*d*) Through and through wounds: Cleanse and await developments.

EXTENSIVE COMMINUTED FRACTURES.—Cleanse, provide drainage.

Essential point in treatment of all wounds is cleansing and the provision of adequate drainage.

DECOMPRESSION.—1. Rarely called for during earliest stage.

2. May be called for by progressive hemorrhage, but there is grave risk of infecting the subdural space.

3. Local abscesses may require this procedure.

Summary.—The operation is rarely called for, and, as a rule, when performed, should be done contralaterally.

NOTES ON OPERATIVE TECHNIC.—1. Irrigate with hot saline (115° F.) during operation.

2. Excise scalp wound.

3. Large Omega (Ω) shaped flap.

4. Remove bone for at least ½ inch around the wound in dura.

5. Be very careful not to disturb adhesions which shut off subarachnoid space.

6. Remove all fragments of bone.

7. If increased intracranial pressure renders operation difficult, do a lumbar puncture and draw off 2 or 3 drams of fluid.

8. Drain the track with a perforated metal tube.

SPINAL INJURIES.

The spinal cord may be injured:

1. Directly by the missile.
2. By in-driven fragments of vertebra.
3. Indirectly, by concussion.

The symptoms produced by the above three types of injury are very similar

Early return of knee- and ankle-jerks is a favorable sign. In hysterical or functional paraplegia sphincter control is not affected, while in severe organic lesions, retention of urine is always present.

Absence of reflexes is invariably evidence of organic injury.

TREATMENT.—Disappointing.

X-ray.—If a skiagram shows a missile or fragment of bone lying against the spinal cord, operate.

Treat Complications.—Irrigate bladder with solution of quinin-sulphate, 2 grains to the ounce.

PENETRATING WOUNDS OF THE CHEST.

If death does not occur immediately, prognosis is good.

SYMPTOMS. — Considerable shock is usually present. Usually, but not invariably, hæmoptysis. Breathing is difficult and painful, and, as hæmorrhage usually occurs into the pleural cavity, there are symptoms of internal bleeding as well as dysp-

nea. Pulse, small and rapid. Diaphragm fixed. Surgical emphysema may occur.

TREATMENT.—Absolute rest. Hypodermic injection of morphin, $\frac{1}{3}$ grain. Repeat, if necessary. Small quantities of liquid food. Do not remove patient for at least a week.

Temperature usually rises within the first forty-eight hours and may remain at about 100° for ten to fourteen days.

Do *not* tap a hæmothorax during the first week unless absolutely necessary, as fresh hæmorrhage will probably occur if this procedure be followed.

Bronchitis may be troublesome.

A three-hour mixture containing 3 grains each of iodide of potassium and carbonate of ammonium usually gives considerable relief.

Infection of the hæmothorax is common and should be treated as an ordinary empyema.

WOUNDS OF ABDOMEN.

A large proportion of men shot through the abdomen die on the field.

INDICATIONS FOR OPERATION.—Wounds of the liver usually do well and seldom require operative interference.

Wounds of the kidney seldom require operation unless for continuous bleeding, in which case nephrectomy should be performed.

WOUNDS OF THE SMALL INTESTINES.—Usually multiple. A primary operation may reasonably be performed under the following conditions:

1. If seen within twenty-four hours of injury and the general condition is good.
2. If only a small part of the whole abdomen has been traversed.
3. If it is certain that the peritoneum has been opened.
4. If patient's condition is becoming worse.
5. If conditions for operation are satisfactory.
6. Pulse rising, or abdomen increasing in rigidity.

After operation, make a careful examination for any bleeding-points before closing the abdomen.

TRENCH FOOT; FROST-BITE.

CAUSES.—1. Prolonged exposure to a low temperature and wet.

2. Restricted circulation in the lower limbs.
3. Lowering of general circulation.

SYMPTOMS. — (*a*) Slighter cases: Anæsthesia, œdema.

(*b*) More severe cases: Cyanosis, gross œdema, bleb formation, serious organic changes.

(*c*) Worst cases: Gangrene.

PROPHYLACTIC PRECAUTIONS.—1. *Loose Boots.* At least one size too large.

2. Keep up general circulation by warmth and movement.

3. Change socks as frequently as possible and keep feet dry.

4. Puttees should be loosely applied.

5. Boots should be thoroughly greased.

6. Hot food should be supplied to the men while in the trenches.

7. Rubber boots have been very extensively used and the result of their employment has been favorable.

8. During the first two winters of the war a method of thoroughly greasing the feet and legs before going into the trenches was extensively carried out and appeared to have good results as a preventive measure. The disadvantages were that the material used (a mixture of whale oil and tallow) was unpleasant, the men did not like it, and septic infection of superficial abrasions was liable to occur.

During last winter, a new method which had been well reported on by the French, was thoroughly tried in one of our Armies. Under this system "trench-foot wash houses" were established in suitable localities a short distance (*e. g.*, two or three miles) behind the front line.

Immediately before returning to duty in the trenches the men were taken, one company at a time, to one of these bath houses, their feet were thoroughly washed with warm water and a special soap, composition of which was as follows:

Soft potash soap	1000 parts
Powdered camphor	25 "
Powdered borate of soda	100 "

The Regimental Chiropodists[1] then carefully attended to the men's feet—corns, abrasions, etc., were treated, the feet were thoroughly dried and were then powdered with a powder composed of camphor, talc, and boracic acid, the camphor being, according to the French, the important ingredient.

The condition of the men's feet improved under this treatment. It was cleanly, the feet were kept in good condition, and the men much liked it, the latter an important point.

There were, however, some possible fallacies, and it is perhaps too early to speak with absolute certainty as to the efficacy of this method of prophylaxis. There is no doubt, however, that during the period when this treatment was in vogue, the condition of the men's feet greatly improved and instances of "trench foot" diminished. At the same time it must be pointed out that during this period there was a very marked improvement in the weather conditions, a hard, dry frost being prevalent for many weeks, and also that, owing to each division occupying a small frontage during this period, frequent changes in the front line

[1] An enlisted man, trained by surgeon for this duty.

troops were possible, and it was at no time found necessary to keep the same men in the front trenches for more than a few days at a time.

GAS POISONING.

The first gas attack on our front took place in April, 1915. The gas used on that and on many a subsequent occasion was chlorine. Being quite unprepared for it, our losses were considerable.

We found on some of the German prisoners, gas protective respirators, which consisted of some cotton waste, loosely inclosed in a bag, of coarse muslin, forming a pad about 6 x 4 inches, with a tape attached to each of the four corners, for the purpose of fixing it around the head.

We manufactured a large number of these masks in a very short time and saturated them before issuing to the troops with a solution of hyposulphite of sodium and ordinary washing soda. Since that time we have introduced many modifications, to meet new devices on the part of the enemy, and at present each officer and man in the front area carries a box respirator and gas helmet.

The British Army is at present, I think, well equipped with protective appliances, and all of our troops are thoroughly trained and practised in their use.

The gas which has been recently used by the

enemy is phosgene, and the remarkable characteristic of this gas is that its poisonous effects are in many cases delayed. A man may apparently be only slightly gassed. He is admitted to the hospital, treated, and to all appearances, recovers, yet some days later he may quite suddenly die from acute pulmonary œdema.

TREATMENT.—The treatment of gassed cases is not very satisfactory, but if the following main principles are carried out the majority of the slighter cases will recover, although it will probably be many months before they are again fit for duty.

Principles of Treatment.—1. *Rest*—absolute, complete, and continuous.

2. Oxygen is of service in cyanosed cases and the Field Ambulances and Casualty Clearing Stations are all supplied with cylinders of oxygen. The gas should be administered by means of a closed mask.

3. Venesection has proved advantageous in cases of severe cyanosis.

4. Vomiting should be induced by tickling the throat with a feather. Ipecacuanha should not be given on account of its depressing effect.

5. Carbonate of ammonium in small doses, administered frequently is the most useful expectorant. Atropin is of no service and is probably harmful.

SUMMARY.—*Rest.* Oxygen Stimulant expectorants. Venesection, if severely cyanosed.

SANITATION IN WAR.

THE Sanitary organization of Units in the field is as follows:

WATER DUTY MEN.

One non-commissioned officer and four men, Royal Army Medical Corps, are attached to each infantry battalion and proportionate numbers are attached to other units. This detachment is for "Water Duty." Our field service regulations, Part I, provides that eight men per battalion may be specially detailed from the ranks of the battalion when required, for duties connected with the provision of a pure water supply.

In addition to these "Water Duty" men a "Sanitary Detachment," consisting of one non-commissioned officer and eight men, is furnished from the ranks of the battalion for sanitary duties.

The men of this detachment wear a badge, "S. P." (Sanitary Police), on the arm, and have all the authority of Military Police. They work under the supervision and direction of the regimental medical officer, and carry out such duties as the preparation and care of latrines and urinals,

the collection and disposal of refuse, construction of ablution places, sanitation of cooking places, slaughtering places, horse lines, etc.

SANITARY SQUAD.

The Sanitary Squad consists of one sergeant and five privates, R. A. M. C.

One such squad is allotted to each road or railway post on the lines of communication.

SANITARY SECTION.

This unit consists of one Officer and twenty-five personnel, R. A. M. C., and its organization and duties may now be considered:

The personnel comprising the Sanitary Section must all have had previous experience in this line of work. The Officer is usually a Medical Officer of Health. The men have been previously trained in sanitary or laboratory duties. Many of them have, in civil life, been civil engineers, plumbers, chemists, etc. It is advisable to appoint the men Lance Corporals, in order that they may carry authority with the rank and file of the Army.

The equipment includes a Foden disinfecting apparatus, which consists of two Thresh's disinfectors, mounted on a motor chassis. Testing cabinets for examination of water are also supplied.

OUTLINE OF DUTIES.—(*a*) When division is more or less stationary, *e. g.*, when it is in the reserve area some miles behind the fighting line, the Sanitary Section's duties will here comprise:

Inspection work, such as is performed by a sanitary inspector in civil life. Special duties, in connection with the supply of water, conservancy of water, bathing and disinfecting arrangements, etc.

SUGGESTED METHODS OF WORKING.—1. A detachment of two or three men from the Sanitary Section is posted to each brigade (three brigades per division) for the supervision of sanitation in that brigade-area.

2. A small detachment is posted to Divisional Headquarters.

3. A detachment (four to eight men) is posted to the divisional laundry and baths, to supervise these.

4. A detachment of two men at each of the bath houses and "trench-foot wash houses" in the divisional area.

The above scheme means that the major part of the Sanitary Section personnel will be split into small detachments, which are distributed throughout the divisional area, supervising sanitation, the general carrying out of disinfecting of clothing, disinfecting of buildings, huts, tents, etc., in cases where infectious disease has occurred, supervising the work of laundries, baths and wash houses, and

generally ensuring efficient sanitation and personal hygiene of the troops.

The laundry work is very extensive and important and requires skilled supervision, to ensure efficacy of working.

Every man in the Sanitary Section is a very fully employed and hard-worked individual and it will be found that there is great competitive keenness and much ingenuity displayed in devising new and improved types of latrines, urinals, destructors, and numerous other devices.

(*b*) When the Division is moving forward into a fresh area, *e. g.*, when the Corps or Army of which it forms part is following up a retreating enemy, detachment of two men with their water-examining cabinets (for metallic and chemical poisons) moves forward immediately behind the forward fighting troops and at once placards as "dangerous" every source of water, well, spring, etc. in the new area. All water being thus "banned" to the troops, the Sanitary Section must then set to work and examine the water, testing for metallic poisons and for gross pollution and examining for chlorine equivalent. The water sources are then placarded according to results found as "dangerous," or "may be used, chloride of lime to be added in such and such proportion," etc. In doubtful cases, a sample is taken and forwarded to the mobile bacteriological laboratory for further examination and report.

The Sanitary Section also notes the *exact* map reference of each water supply, the nature, *e. g.*, "spring," "well 25 feet in depth," "well 160 feet in depth," etc., and also any special suggestions, such as the erection of a coping, provision of a windlass, rope and bucket, the fitting of a cover, etc.

The A. D. M. S. of the Division will either himself inspect or depute an officer to do so, the various water supplies in the area, the net result of the total procedure being that by the same evening the Divisional Headquarters Staff can be furnished with an exact survey of all water supplies in the new area, their nature, and any steps which should be carried out by the Royal Engineers.

The water supply having been dealt with, attention is turned to such matters as the burying of horse carcasses, the destruction of refuse, etc. Here the A. D. M. S. will obtain fatigue parties from the fighting troops, several hundred in number if necessary, who will work under the direction of the O. C. Sanitary Section and it is frequently astonishing to see how completely transformed an area may become in twenty-four hours, as a result of hard manual work carried out under skilled supervision and intelligent direction.

Convalescent men from fighting troops in the Division are furnished for temporary light duties, to the Sanitary Section, from the "Divisional Rest Stations," as required. These men carry out light

work (gradually increased) at the baths, laundries, etc., under the direction of the Sanitary Section, for a week or more before rejoining their units in the fighting line. By this method the Sanitary Section has usually an average of fifty men available for duties in the establishments under their control, while, at the same time, these men have the advantage of having their work "graduated" between convalescence and duty.

The above is only the writer's outline of a few of the many duties of the Sanitary Section. These notes do not represent official rulings or directions, but are the outcome of a certain amount of experience, and the method of work has obtained good results.

There is a Sanitary Officer (R. A. M. C.) with the headquarters of each Division, Corps and Army, and there are specialist sanitary officers at all the bases, who are furnished with fully equipped laboratories.

There is also a mobile motor laboratory with each Army, so that specimens, such as swabs from the nares of possible meningitic cases, samples of water, etc., can be quickly examined and reported on.

Let us now consider the method by which sanitation is carried out from the front line to the base.

(*a*) IN THE TRENCHES.—1. *Food.*—The rations are brought up as far forward as may be possible, usually to the brigade headquarters, in horse wagons or motor lorries, thence the food is distributed

by hand carriage to the Regimental Headquarters, which is usually situated in a dug-out. The food is cooked in dug-out kitchens situated in this vicinity and carried thence by hand in jacketed hot-boxes to the trenches in the firing line. There are stoves in the support trenches in which a certain amount of cooking can be done and where socks, etc., can be dried

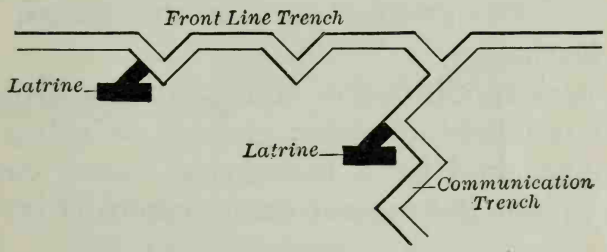

FIG. 22.—A trench within a trench.

2. *Water.*—The men in the trenches have their water bottles which are replenished from a supply of water brought up by hand in petrol tins from tanks, situated probably in the vicinity of the Regimental Headquarters.

3. *Conservancy.*—During the earlier stages of trench warfare disposal of excreta was carried out in a somewhat primitive manner, but the long continuance of this mode of warfare has led to many modifications and improvements which we shall now consider.

The fæces were buried in latrine trenches dug as offshoots from the trench system.

(*a*) Objections.—The trenches might be occupied for a very considerable period, fresh latrine trenches would constantly require to be dug, and the extent of soil pollution after an occupation of some months may readily be imagined.

(*b*) After a heavy rainfall the latrines were liable to become flooded, with a consequent conversion of the greater part of the trench system into a latrine.

The next modification consisted of a filth trench constructed behind rising ground or other shelter and approached by a transverse trench cut as an offshoot from the main trench system (Fig. 23).

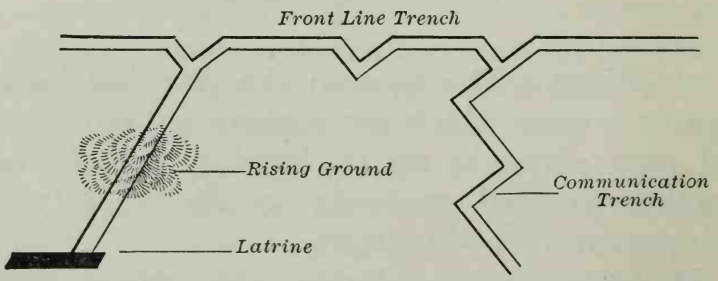

FIG. 23

Removal System.—Buckets are placed in bomb-proof dug-outs in the trenches. The buckets are removed by the troops who are being relieved, who

bury the contents in a deep trench dug for the purpose, some distance, probably several hundred yards, behind (Fig. 24).

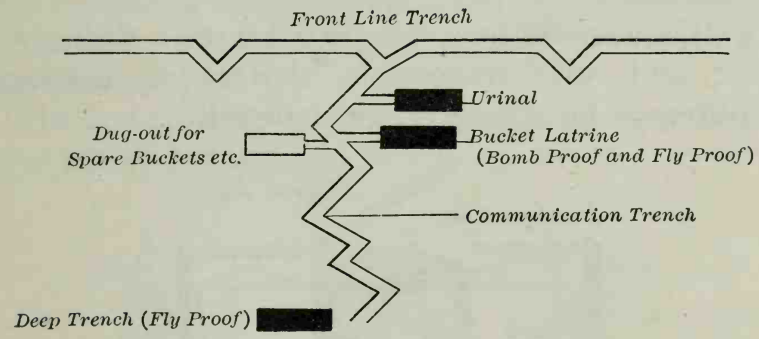

FIG. 24

The empty buckets are brought up by the next relieving troops and are meanwhile replaced in the latrines by spare buckets on the spot.

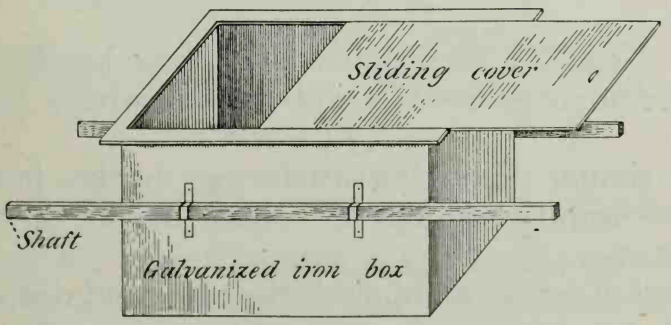

FIG. 25

Difficulties.—Most evident in low-lying ground but can usually be overcome in this method, as the

position for deep burial trench can be selected according to the lay of the ground.

Types of bucket latrines for use in trench conservancy:

(*a*) Galvanized iron box, fitted with a sliding tin cover and two removable shafts for carriage. Requires to be specially constructed.

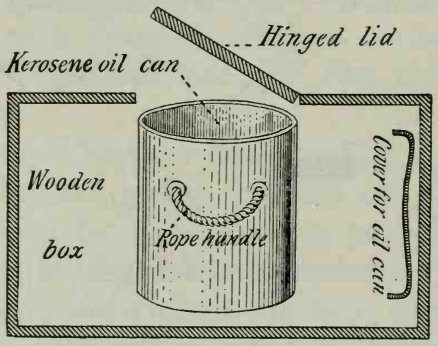

FIG. 26

(*b*) Kerosene oil tin, fitted with rope handles and a wooden cover inside a wooden box with a hinged lid.

On similar principles satisfactory bucket latrines can be improvised out of Cresol drums or other receptacles.

The following combined incinerator and deep filth trench has been used with satisfactory results:

The lid is lifted and the latrine buckets are emptied into the trench by the party of men relieved from the trenches.

Every morning some straw, waste paper, rubbish, etc., are thrown into the trench and set on fire, burning usually lasts for a couple of hours. By this method a considerable quantity of the excreta is burned, the more liquid portion gravitating to the soakage pit.

The trench is fly-proof and lasts for a considerable time before being filled in.

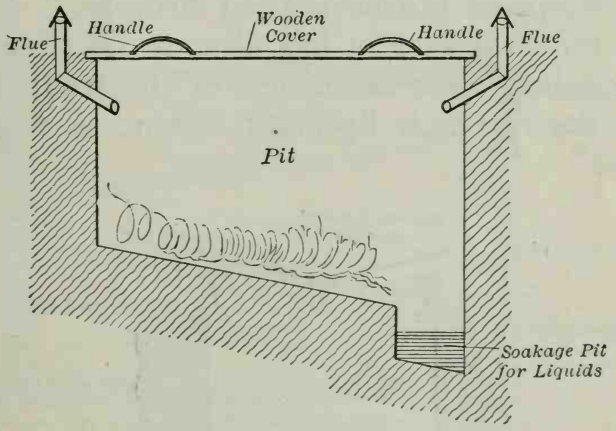

FIG. 27

CONSERVANCY IN HUTTED AND TENTED CAMPS.

DISPOSAL OF EXCRETA.—1. *Burial.*—(*a*) *Fœcal Trenches.* — Long and Deep. Objections, fouling of ground. Narrow and shallow, three feet long, two feet deep, one foot wide. Allow five such trenches to every 100 men, or if the number of troops is 500 or more, allow 3 per cent.

If such trenches are used a notice as follows: "After using this latrine throw some loose earth in the trench," should be posted in front of each set of trenches. A hand scoop should invariably be provided at each latrine.

Frontage in Yards.—Six times the number of hundreds of men, *e. g.*, 200 men require twelve yards of latrine frontage. Nowadays either a removal system of bucket or box latrine or a deep trench fly-proof latrine is used entirely.

The removal system has already been described when dealing with sanitation in the trenches.

The deep trench fly-proof latrine is made as follows:

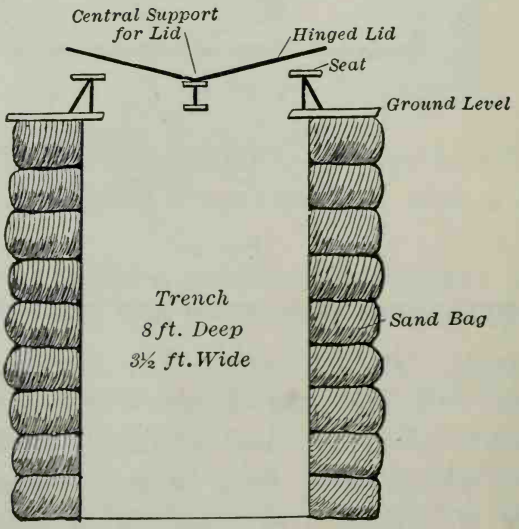

FIG. 28

Latrine trenches should be situated where no contamination of water supply is possible and not less than 100 yards from, and to leeward of kitchen. The trench contents and surroundings should be sprinkled with a 5 per cent. solution of cresol to keep off flies.

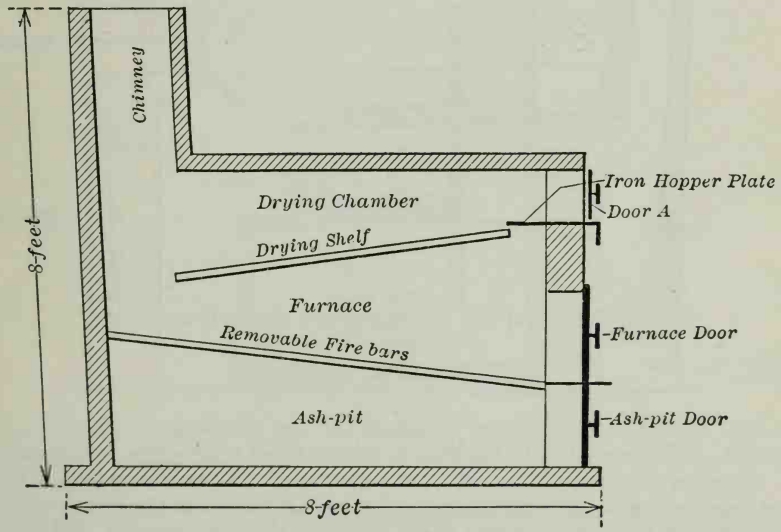

FIG. 29.—Fixed incinerator, with drying shelf. The damp refuse is pushed through door *A* into the drying chamber, where it is exposed to the heat of the furnace. When dry the refuse is pushed over the edge of the shelf into the furnace. The "drying shelf" is made of perforated iron. This pattern may be used for incineration of fæces.

2. *Incineration.*—A combined method of incineration and burial has already been described, and this principle may readily be applied to latrines.

Incineration presents many difficulties, not the least of which is the provision of fuel; 1000 men

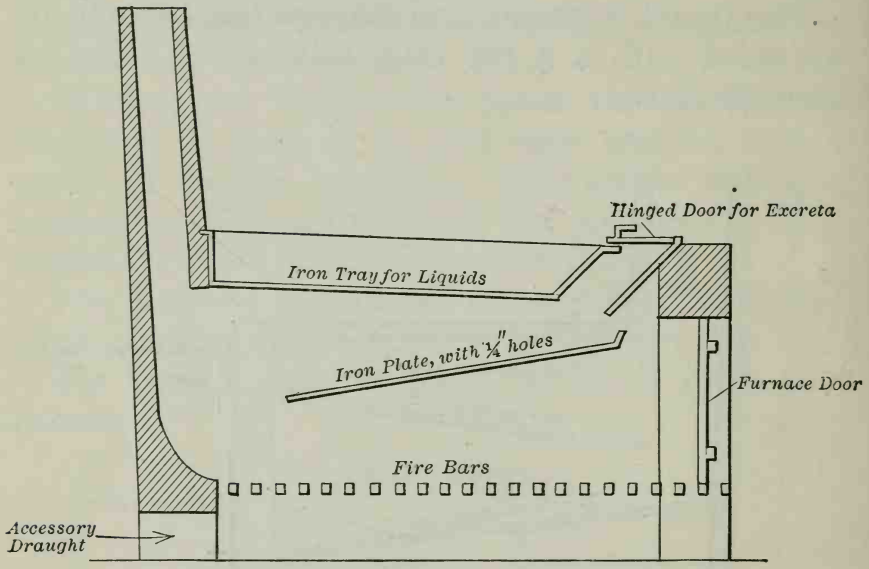

FIG. 30.—The "McMunn" incinerator and evaporator for solids and liquids. The iron tray in the roof is partly filled with urine and sawdust. A vigorous fire is maintained in the furnace. When the tray contents are thoroughly hot the saturated sawdust is raked over the edge onto the sloping iron plate, and, when dried off, into the fire beneath. Fæces are thrown down the hopper and follow the same route. This installation requires careful attention and needs one man to look after it. Twenty-four hours' work: 130 gallons of liquid disposed of; 200 men's excreta disposed of; 180 pounds of wood and 50 pounds of sawdust refuse expended as fuel.

provide 100 pounds of solid and 500 pounds of liquid excreta per diem in the latrines; if sawdust is obtainable, some 50 to 60 pounds of this, with dry

horse litter, will be found sufficient fuel to incinerate the solid excreta.

INCINERATORS.—(*a*) *Open Types.*—Objections: Slow to make and start. Wasteful of fuel. Production of offense. Liable to be put out by rain. Contents may be blown over camp.

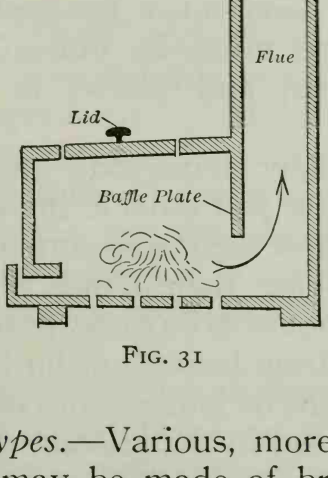

FIG. 31

(*b*) *Closed Types.*—Various, more or less improvised patterns may be made of brick, galvanized iron, etc.

Field Destructor.—This destructor has 16 cubic feet furnace capacity, and should suffice to destroy the total excreta of a unit 1000 strong in ten hours.

Kitchen Refuse.—A covered receptacle should be provided immediately outside each kitchen for the reception of all refuse, and the contents

should be removed from this to the incinerator twice daily or oftener if necessary.

A tin or box should similarly be placed outside each tent or hut for the collection of food fragments or refuse.

Kitchens.—No caps or other clothing should be hung up or kept in the kitchen.

The cooks should be provided with clean aprons.

The following notice should be posted in every kitchen: "All food must be kept covered from flies. All refuse must be immediately removed from the kitchen and placed in the receptacle outside."

A basin of water, with soap and towels should be always at hand just outside the kitchen in order that the cooks and their assistants may have every facility for keeping their hands clean.

Meat safes should always be provided, they can easily be made from boxes, muslin bags, etc.

Half-empty tins of jam and pieces of cheese must not be left exposed in the kitchen or food stores.

WATER.

Each man in the field requires daily the following amount of water:

(*a*) *In camps*, 3 gallons. An additional 2 gallons per head per diem will be required if clothing is washed.

(*b*) *In bivouacs*, etc., for drinking and cooking only, 1 gallon.

EXAMINATION OF WATER SOURCES.—(*a*) *Wells.*—Note as to whether the well is protected by:

1. Lining by stone, brick, etc.
2. Provision of a cover.
3. Coping around edge.
4. Provision of a pump.
5. Sufficiency of depth (so as to ensure filtration).

(*b*) *Springs.*—"Land" springs. In these the water flows above an impermeable stratum. Should be regarded with suspicion. "Main springs, underground reservoirs beneath impermeable strata.

(*c*) *Streams.*—Liable to contamination.

The motor laboratories, already mentioned, have proved of immense service in carrying out rapid and efficient bacteriological examination of water supplies.

In the British Army we no longer rely on the "filter water-carts" as being an effective filtering agent, and we now use the cart simply as a movable tank or water container.

Care must be taken that the interior of these carts be kept scrupulously clean by frequent scouring with a solution of chloride of lime.

The method of water distribution and purification on the Western front is now carried out as follows:

Water is conveyed by pipes to various "water points," situated throughout the area of operations.

Tanks are established at these "water points" from which the water carts are filled. The water is sterilized by the addition of a definite quantity of chloride of lime, the amount to be added varying with the nature of the particular water supply.

FLIES.

The importance of flies as potential carriers of disease is already well known. As Mr. Gordon Hewitt remarks, "The house-fly is a winged and wandering bundle of bacteria."

LIFE HISTORY.—The *eggs* hatch in from eight hours to four days into

Larvæ, or maggots, which exist as such for two or three days and then enter into the stage of the

Pupa, or chrysalis, which after five to seven days hatches into the

Mature fly.

The fly becomes sexually mature in ten to fourteen days after having been hatched.

Four days after mating the females lay their eggs in batches of about 120 and may lay five or six such batches during her life.

"In very hot weather the progeny of a fly may be laying eggs in about three weeks after the eggs from which they were hatched had been deposited." (Hewitt.)

MODE OF FEEDING.—When a fly feeds it moistens and renders soluble the substance, by discharging on it a flow of saliva; it also regurgitates a portion of the previously swallowed meal.

FLIGHT.—Flies can travel up to a mile from their hatching places.

PROTECTIVE MEASURES.—1. Destruction or protection of infected material, *e. g.*, rendering of the latrines fly-proof, early destruction of all infected material.

2. *Anti-fly measures:*

(*a*) Prevention of fly-breeding.

(*b*) Prevention of access of flies to human excreta.

(*c*) Destruction of flies.

(*d*) Protection of food.

We will now consider each of these measures:

(*a*) PREVENTION OF FLY-BREEDING.—Attack the breeding grounds.

Moist stable litter and horse dung or human excreta form the favorite media for the deposition of the eggs.

The use of *chemicals* is generally impracticable on active service.

Incineration.—So far as possible each day's horse manure should be burned within twenty-four hours. It is difficult to carry this out satisfactorily in wet weather, especially when large quantities of manure have to be dealt with. When the quantity is not excessive the greater portion or all may

be completely burned by the use of wire frame incinerators, somewhat after the following pattern:

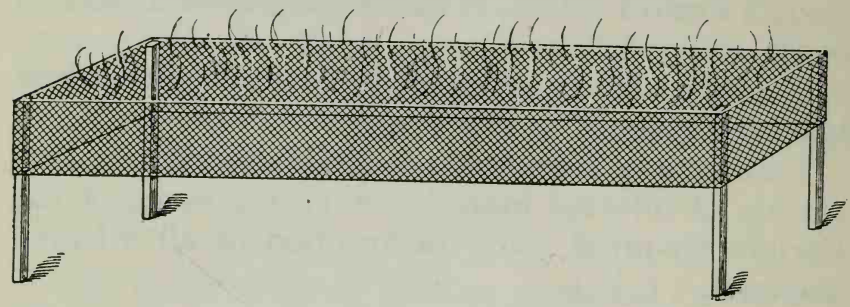

FIG. 32

When large heaps of horse litter exist much may be effected by raking the surface and edges daily and burning as much as possible.

Close Packing.—House-fly larvæ will not tolerate a temperature of 100° F., and both larvæ and eggs are quickly killed at any temperature above 114° F.

The heat generated by closely packed stable manure is usually 130° F. or higher. Taking advantage of this fact we make the manure into closely packed "dumps" on hard ground, the surface of the smooth, hard ground should extend three or four feet beyond the edges of the "dump." As fresh manure is added it should be firmly beaten down and the surface smoothed with shovels, water being added if necessary.

Spreading.—In hot, dry climates, such as India, manure may be quickly desiccated, and any larvæ or eggs which it contains killed by spreading it in thin

layers on the ground and so exposing to the sun. This method is not applicable on the Western front.

(*b*) PREVENTION OF ACCESS OF FLIES TO HUMAN EXCRETA.—Fly-proof latrines should be employed whenever possible. The shallow, open latrine trench is a standing danger. Chloride of lime does *not* exclude flies from latrines. A solution of 5 per cent. cresol or equal parts 5 per cent. cresol and paraffin, will act as deterrents, and the latrine seats and trenches should be daily sprinkled or sprayed with such a solution.

(*c*) DESTRUCTION OF FLIES.—1. Fly traps of various patterns. The following diagram may illustrate an efficacious form of trap; it is comparatively easy to improvise other patterns on the same principles:

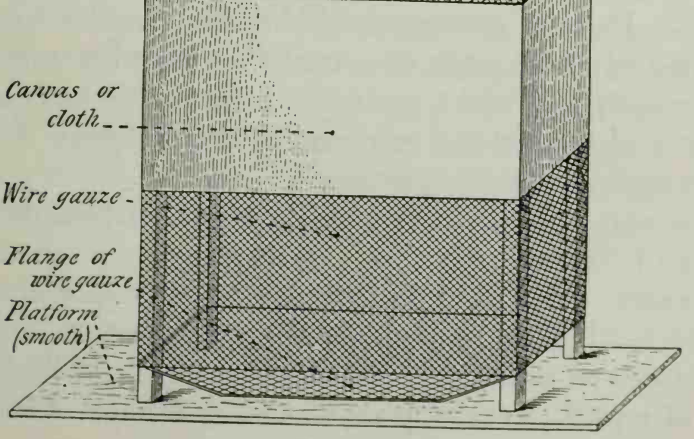

FIG. 33

The bottom bar of the trap frame is raised $\frac{1}{2}$ inch from the surface of the platform. From the bottom bar a wire gauze flange, 4 inches wide, projects inward all around, sloping downward so that the inner edge is $\frac{1}{4}$ inch from the platform.

Some bait should be placed on the center of the platform under the trap

When a sufficient number of flies are caught they may be killed by petrol fumes or other means.

2. "*Tangle Foot.*"—Heat 5 parts (by weight) of castor oil and 8 parts (by weight) of powdered resin until the resin is completely dissolved; do not let the mixture boil, but apply while hot, as thinly as possible, to glazed paper, wire, or hoop-iron.

3. *Poisons.—Sodium Arsenite.*—$15\frac{1}{2}$ grains dissolved by heating in $3\frac{1}{2}$ ounces of water and 25 per cent. sugar added. Expose this solution in tin trays (taking proper precautions) in suitable situations. Pads of cotton-wool should be placed in the trays and these pads moistened as they become dry.

Formalin.—Add 3 per cent. formalin to sweetened milk and water and expose in saucers with a cube of bread in the center.

Sprays.—"Cinol," "exol," etc., containing extract of "pyrethrum."

Fumes.—Burning pyrethrum powder quickly stupefies both flies and mosquitoes in a room.

Fumes of petrol have a similar effect. The burning of equal parts of phenol and camphor, 4 ounces

per 1000 cubic feet, quickly kills all the flies in the room, all apertures being first closed.

(*d*) PROTECTION OF FOOD. — When possible, kitchens and dining-rooms should be made fly-proof by double wire-gauze doors with a short corridor between. All food should be kept covered from flies by "safes" or similar means. Cheese, sugar, and jam are frequently overlooked in this respect.

LICE.

The body-louse has been an abominable and almost universal pest during the present campaign.

Lice carry the virus of typhus fever, relapsing fever, and probably the so-called "trench fever."

LIFE HISTORY.—The female louse lays five eggs at one sitting and may produce a total of 125 eggs. The eggs are usually laid in the body-clothing, especially at the seams, and, as a rule, hatch in six to twelve days; but the hatching may be delayed for as long as six weeks if the conditions are unfavorable.

Sixteen days after having been hatched the female louse may commence to lay eggs. The louse probably lives seven or eight weeks, but cannot survive separation from the human body for more than nine days

SOURCES OF INFESTAT ON —

(*a*) Living places.

(*b*) Blankets, straw, etc.

(*c*) Personal clothing

The last named is infinitely the most important.

PREVENTION AND DESTRUCTION.—(*a*) *Personal Cleanliness.*—The battalion medical officer should inspect the men of his unit at least once weekly. Baths, disinfection, and the washing of clothes must be carried out on every possible occasion.

Laundries are now established in every area and the clothing before being taken to the laundry is disinfected either by means of Thresh's disinfector, or by the Clayton machine (sulphurous acid).

(*b*) *Heat.*—Boiling water and steam kill the lice instantly and the eggs in one and a half minutes.

The heat at which a flat iron is normally used kills lice and eggs instantly.

(*c*) *Liquids.*—Immersion in 0.5 per cent. cresol kills lice and eggs within an hour.

(*d*) *Powders.*—"N. C. I." powders.

Naphthaline	96 per cent.
Creosote	2 "
Iodoform	2 "

This powder is an effective killing agent, but it is irritating, and on this account should not be used too freely, especially in the region of the fork.

Keating's powder, "pyrethrum," is not very efficacious, although better than nothing.

(*e*) *Ointments.*—"Vermijelli."

Crude mineral oil	9 parts
Soft soap	5 "
Water	1 part

This ointment should be smeared at least once weekly on all inner seams of the clothing.

Crude Oil Ointment.—Melt 2 pounds of soft paraffin and add 4 ounces of crude tar oil. This is reported to be more efficacious than "vermijelli," and should be used in a similar manner.

SUMMARY.—1. Disinfection and washing of the clothing whenever opportunity occurs, *e. g.*, when the division is relieved from the trench and comes into a "rest area."

2. Application of crude oil ointment and "N.C.I." powder every four days.

DIVISIONAL BATHS.

Each division should institute at least one bath, capable of dealing with 1000 men per diem. Most divisions can now arrange to bathe at least 2000 men per diem.

The object to be aimed at is that the man should "shed" his entire clothing, have a satisfactory hot bath, clothe himself in fresh washed and disinfected clothing, and return to his billet, with disinfected blankets.

If these objects are attained, such a man should, on return to his billet, be perfectly clean and his clothing and bedding entirely free from vermin.

Fig. 22 and short description may possibly illustrate how these objects are, so far as possible, attained.

GROUND PLAN OF A DIVISIONAL BATH

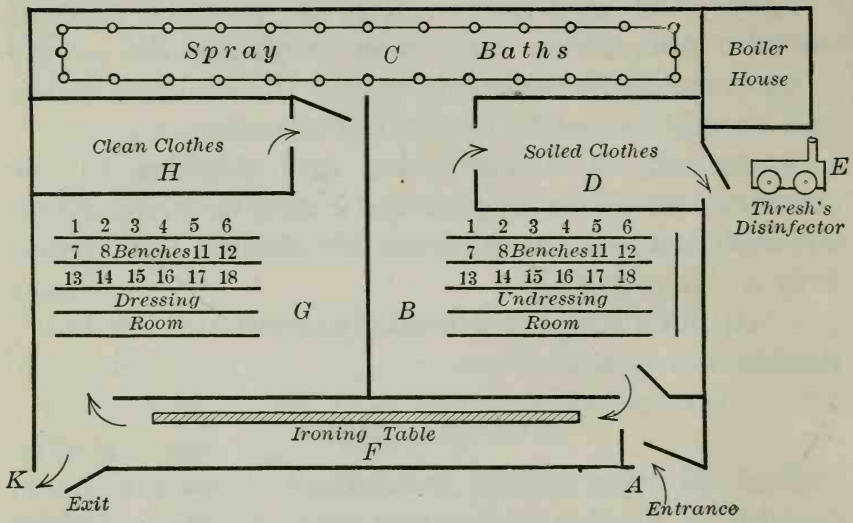

FIG. 34.—Ground plan of a divisional bath. The men to be bathed enter at *A* and pass into the undressing room, *B*, where they undress. Each man places his clothes on a bench having a number, *e. g.*, "7," "9," etc., and then passes on into the spray-bath room, *C*. An attendant passes the underclothing into the soiled-clothes room, *D*, whence it is passed out to the disinfector, *E*. The attendant then tickets the breeches with a number corresponding to the bench number and passes them into the ironing room, *F*, and takes the boots, puttees and coats, similarly ticketed, to the dressing-room, *C*, where they are placed on a corresponding bench number. The men having washed pass on to the dressing room, *G*, receiving clean underclothing from the clean-clothes room, *H*, as they pass. The breeches, and, if necessary, the coats, having been ironed and the seams greased with "vermijelli" or similar ointment, are placed in the dressing room and the men having clothed themselves, then pass out at the exit, *K*. The underclothing, after disinfection, is sent to the divisional laundry, and having been washed and repaired, is returned to the clean-clothes room in the bath house for reissue to the next batch of men on the following day.

Blankets are sent for disinfection in the early morning and are returned, disinfected, the same evening.

The above plan may need considerable modification, owing to local conditions, *e. g.*, it may sometimes be possible to have the laundry and bath house in the same building, which much facilitates matters.

In other cases, when water is scarce, it may be necessary to use the same water several times over by means of a system of clarification and filtration.

INFECTIOUS DISEASES.

These require to be constantly watched for and guarded against. It is by early detection and prompt action that an outbreak which may have serious and far-reaching consequences should be prevented.

Any suspicious cases should be at once isolated until diagnosis is confirmed, either positively or negatively. All "contacts" must be segregated.

"Carriers" must be carefully watched for. The following are the chief diseases in which apparently healthy "carriers" may spread the disease.

Typhoid.
Paratyphoid.
Dysentery.
Diphtheria.
Cholera.
Cerebrospinal meningitis.

No men who have recently suffered from enteric fever or dysentery should be employed at "water points" or in kitchens.

Men suffering from diarrhea should be early placed under close observation.

CEREBROSPINAL MENINGITIS.

On the occurrence of a suspicious case the patient must be at once isolated and placed under treatment.

His clothing, bedding, and quarters must be disinfected. All "contacts" are to be segregated in well-ventilated quarters. Swabs from the nasopharynx should be taken in the case of each "contact" and sent to the mobile bacteriological or other laboratory for examination. Pending the result of this examination the men should be treated by nasal insufflation and gargles twice daily.

Those in whom the results are negative and whose throats are normal may return to duty.

Any who are reported as "carriers" should be transferred to other quarters and isolated until two successive swabs taken from the nasopharynx at intervals of several days are reported as negative.

METHOD OF TAKING THE SWABS.—The swabs should be free as possible of saliva, and cultures should be made as quickly as possible.

In order to carry out the first desideratum a covered swab-carrier, such as West's, should be

used. The covering tube carrying the swab is passed behind the soft palate, the swab is extruded so as to come in contact with the nasopharynx, and is then drawn back within the covering tube and both are withdrawn from the mouth.

I trust that the foregoing brief lectures may convey some of the conviction which we officers of the R. A. M. C. feel as to the immense importance of sanitation in an army in the field.

The last twelve years' sanitary efforts have shown greatly improved results in our Army.

As an example I might quote the case of our Army in India:

From 1903 to 1912 the following results were obtained:

The enteric death-rate fell to less than 9 per cent. of the 1903 rate.

The invaliding rate fell to less than 23 per cent.

Total death-rate fell to less than 35 per cent.

Constantly sick rate fell to less than 46 per cent.

These figures represent an actual annual saving of

600 lives,

1500 invalided from the service,

2300 average sick in the hospitals.

As regards cholera, in 1869 we had 972 deaths among the British soldiers from this disease.

In 1912, with a much larger army, we had 14 deaths.

Antityphoid inoculation is voluntary in our Army, but the belief in its efficacy is so general that in 1913 over 90 per cent. of the British troops in India had been inoculated.

We have numerous instances in history of the disastrous condition to which an army may be brought by disease, and it is only by constant and unremitting effort that incidence of disease can be kept at a uniformly low level.

APPENDIX.

GENERAL NOTES FOR SERVICE ON THE WESTERN FRONT.

OUTFIT WHICH IT IS ADVISABLE TO TAKE.

1. Two complete suits of uniform. Be sure that the jackets are easy fitting, in order that during cold weather thicker underclothing and a jersey or waistcoat may be worn.

2. A well-fitted housewife, with needles, thread, buttons, etc.

3. All other articles of clothing and equipment as required by the Regulations of the United States Army. It will be found convenient to take a pair of khaki trousers for wear in the evening at mess, etc.

N. B.—Cameras are *not* permitted anywhere on the British area of operations.

BILLETING.

Officers who go over for service with the British Army will find no difficulty in this respect, as units are already established in all areas, and billets will be provided for them.

MESSING.

Living expenses while on service on the Western front are distinctly small. Fifty dollars per month should easily cover all necessary expenditure, and, as a general rule, the cost of living, although steadily rising, is below that figure.

SOCIAL CUSTOMS.

It will be a safe general rule to salute every French officer, whether Senior or not.

CENSORSHIP REGULATIONS.

These are strict. No reference in any letters should be made to location of officers or units, the number of casualties, or to any military affairs.

In the British Army, regulations as to "communications to the press" are extremely strict. No "communication to the press," whether on professional or other matters, is permitted to be sent, except through official channels, that is, forwarded through the Commanding Officer.

HINTS.

1. Avoid criticism of the action or orders of a Senior officer. It should be borne in mind that the officer issuing an order is probably in possession of information of which the recipient of the order has no knowledge.

2. An officer should stand *in loco parentis* with regard to the men serving under him. If in difficulty or trouble a soldier should appeal to his officer for advice or assistance, with every confidence that any difficulty will be smoothed for him and any just grievance will obtain prompt redress.

3. *In Regard to Patients.*—The British soldier regards his medical officer with the most unbounded confidence and places absolute reliance in his skill and judgment, therefore—Never make a perfunctory examination or give a hasty opinion.

Spare no pains to ensure that the soldier's confidence is invariably justified.

4. The keystone of efficiency in the Army is "*Loyalty.*" "Loyalty" to the Army and to the medical profession, "loyalty" to one's unit and Commanding Officer, "loyalty" to one's Juniors.

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